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Tunnel and Snowsheds in the Cascades: Great Northern Ry.

The Great Northern Ry., in its crossing of the Cascade Mountains, has had to contend with severe difficulties due to snowfall and snowslides, and the interruptions thus caused have become more serious with the increase in traffic over the line. The heavy snowfall in the Cascades during the winter of 1912-13 led the railway to construct very extensive additional snowshed protection, and to carry on the work as rapidly as possible in order to have it in service during the winter of 1913-14.

The work was principally on the west slope of the range, between Tye and Scenic, Wash., where most of the trouble has always been encountered. Of the 12 miles of line between the Cascade tunnel and Scenic, eight miles are protected either by tunnel or snowshed. The work was done in connection also with the double-tracking of the line, and included a stretch of double-track tunnel. Fig. 2 is a plan of six miles near Scenic, with a double loop and the new tunnel. For information and plans we are indebted to Ralph Budd, Chief Engineer of the Great Northern Ry. The local engineers in charge were O. S. Bowen, Resident Engineer, at Seattle, and K. K. Kuney, Assistant Engineer on the work; they have assisted in preparing the descriptions given herewith.

As the double-tracking of the line over the mountain division is contemplated, it was advisable to put in double-track construction wherever the line is finally located and where the amount of excavation and other work would not be so great as to render doubtful the completion of the snowsheds before Nov. 1. The work done during the season of 1913 provided for the protection of 15,126 ft. of track (as noted below), and required the placing of 25,000,000 ft. b.m. of timber and 57,000 cu.yd. of concrete.

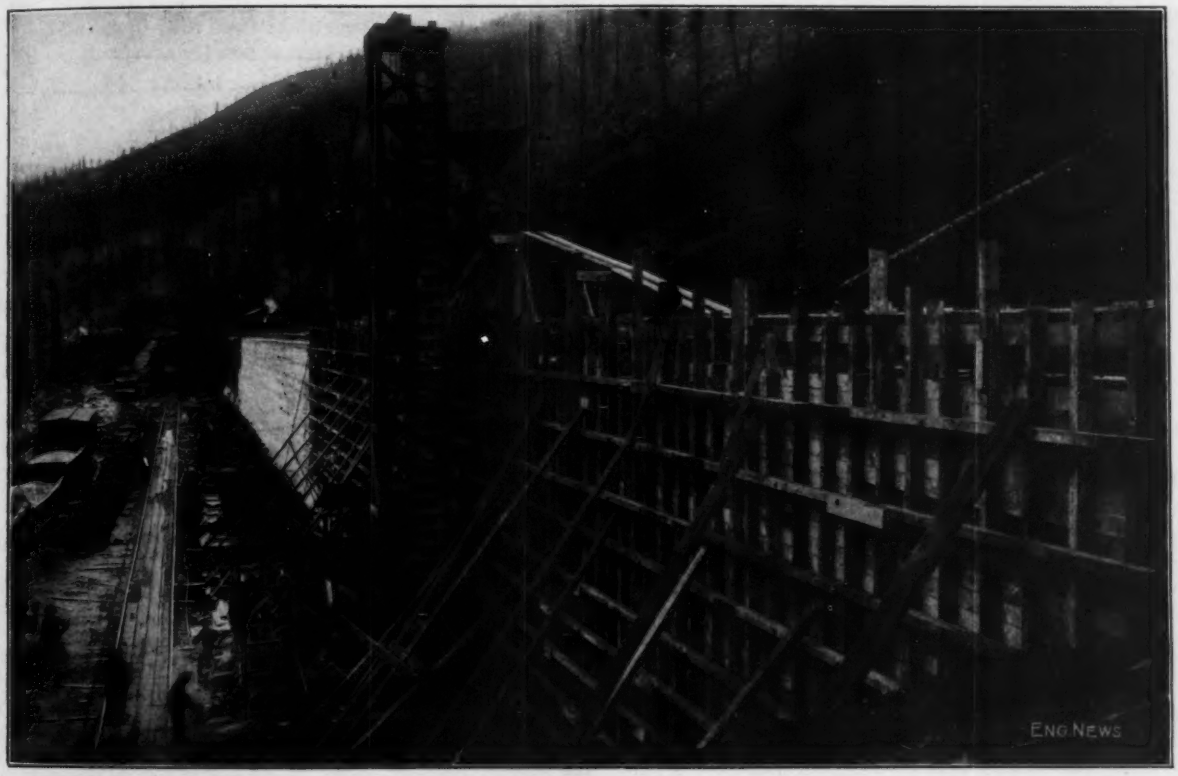


FIG. 1. CONSTRUCTION OF A COMBINATION CONCRETE AND TIMBER SNOWSHED; GREAT NORTHERN RY.

(The concrete mixing and elevating plant is at work on the back-wall. Beyond the finished portion of the wall is a part of the timbering erected, with the timber handling derrick mounted on the roof. On either side of the track are the concrete pedestals for the timber posts. At the left is the material train.)

	ft.
Double-track tunnel	1202
Double-track concrete and timber snowshed	4378
Double-track timber snowshed	1234
Single-track timber snowshed	8312
Total	15,126

The principal items of interest in connection with the handling of the work described were the immense amount of material which had to be delivered daily on the work and the amount of train service involved in handling it. About 6000 cars of material were used during the season and when the work was at its height as many as 70 cars of material were handled daily. At no time was there storage room to unload material to last over 24 hours, and any delay in getting it on the ground would have meant a shutdown of the contractor's plant, but delays caused by this were almost negligible. The handling of this material without interfering with regular traffic was a very difficult matter and required close cooperation between the contractors, the operating department and the engineering department.

All the work described was within a distance of eight miles. At one time there were seven work trains on this district, which does not include any regular or hauling trains. Weather conditions in the early spring were bad but the weather in the fall was especially favorable. No difficulty was encountered in securing labor, and as many as 1800 men were employed at one time.

Location and Topography

The location of this part of the line is interesting. From the west end of the Cascade tunnel, at Tye, it follows down the steep hillside in a southwesterly direction for about two miles, until it reaches an unusually steep place in the mountain called "Windy Point" (Fig. 2). There it turns through an angle of 90° to the right to follow the hillside in a northwesterly direction for about three miles, and then turns through an angle of 180° to the left in Martin Creek tunnel, crossing the creek at each end of the tunnel and doubling back on the same hillside but at a lower level. This slope is followed for three miles to Scenic, which is almost directly below "Windy Point." Here the line turns again through an angle of 180° to the right and crosses Tye River, toward Alpine. Thus, between Tye and Alpine, it makes a double loop describing a huge letter S; two legs are on the same hillside, one above the other; the third is across the Tye River and still lower, as the entire double loop is on a 2.2% grade.

The slopes of the mountain from Tye to Scenic run from 40 to 90°. These steep slopes, together with the location of the lines, one above the other on the same slope, between Windy Point and Scenic, account for the extensive snow protection required in that territory. The whole line between these two points faces south. The protective forest cover has been reduced to a minimum. In addition to these conditions favorable for the formation of slides, any avalanche hitting the upper leg of the loop of the line, must, in its downward course, also strike the middle leg before it is stopped at the bottom of the Tye Valley. It will be easy to see, therefore, why it has been found necessary to protect almost 60% of the distance between Tye and Scenic with snowsheds.

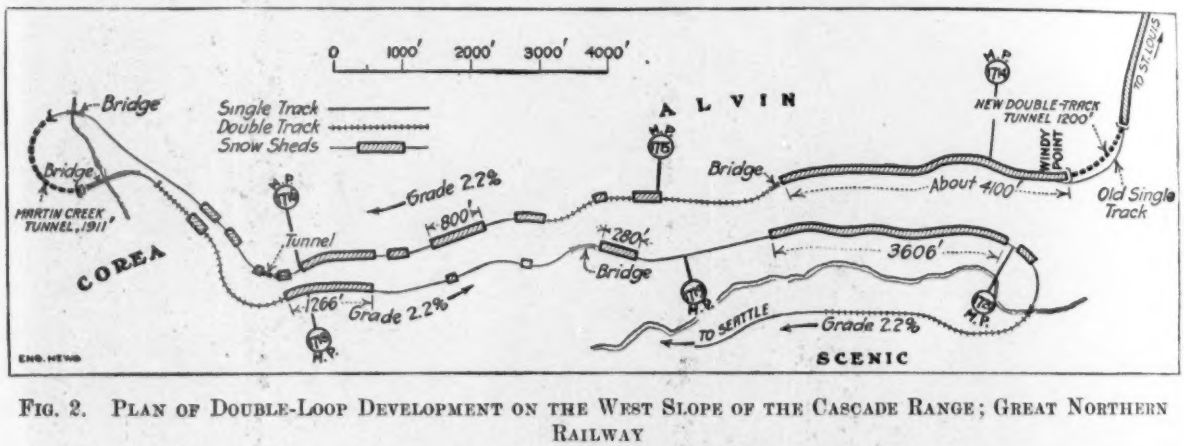


Fig. 2. Plan of Double-Loop Development on the West Slope of the Cascade Range; Great Northern Railway

(Showing the snowsheds and tunnels.)

Camp conditions were good and sanitary conditions were specially good. The percentage of fatal and serious accidents was small, and the accidents were in the most part due to the carelessness of the employees.

The material for the work was ordered as early as February. Timber began to arrive in March and was temporarily stored at Gold Bar, some 40 miles from where the sheds had to be built. Considerable timber was here framed in advance. The contract for the timber sheds was let in March, and they were completed Oct. 15. The contract for the combination sheds was awarded in May, and they were completed Nov. 15. The first train ran through the new tunnel Dec. 17.

All material had to be supplied and hauled by train, as it was required for use, as there are practically no storage places along the line of the work. The average length of train haul was 80 miles for concrete material and 100 miles for timber. Considering the fact that the work of construction was done in six months without interruption to the regular traffic of the Great Northern Ry. during the busiest time of the year, it will be realized that a big task was accomplished under difficult conditions in a very short time.

The Double-Track Tunnel

At Windy Point, the present line follows along a rocky cliff, which is almost vertical in some places. To excavate the solid rock for a double track along this route would have been very expensive. To build an embankment is impracticable, as there is a drop of about 700 ft. down a sheer cliff to the bottom at Tye Creek. It was decided, therefore, to throw the line into the mountain by building a double-track tunnel some 1200 ft. long, incidentally affecting a great improvement in the align-

ment. The tunnel shortened the line, reduced the cost of the permanent double-track location, and provided complete protection against snowslides. The contract was let to Grant Smith & Co., who had to remove several feet of snow to provide a site for the camp and power plant.

Work on the approaches was started May 15, but it was at once apparent that the character of the ground at the east end would make it impossible to complete this in time to work the tunnel from both ends. This east approach, 500 ft. long, was a side cut along the existing line, with about 100,000 cu.yd. of excavation. Being in rotten granite, with seams of hard material, it was difficult to handle the work without causing delays to traffic, and no work either in bench or heading was done from the east end of the tunnel.

The work was concentrated at the west end, therefore, first, the shovel was operated by steam, using coke as fuel, but when it was in about 400 ft., there was considerable trouble from the gas, and as most of the drilling in the heading had been done, the compressed air was used on the shovel. For the 300 ft. of bench at the east end, the mucking was done by hand, through the adit.

The tunnel section, with timbering, is shown in Fig. 3. The tunnel is timbered throughout, the sets varying from solid to 4-ft. spacing, but in most of the work the sets are spaced 2 ft. c. to c. The east end of the tunnel was driven out from the inside, and the timbering was all completed before the portal was broken through. The tunnel section is made large enough to provide for a future concrete lining.

For 134 ft. from the west portal, the tunnel was excavated to the full double-track section, but as it was evident that the work could not be completed within the

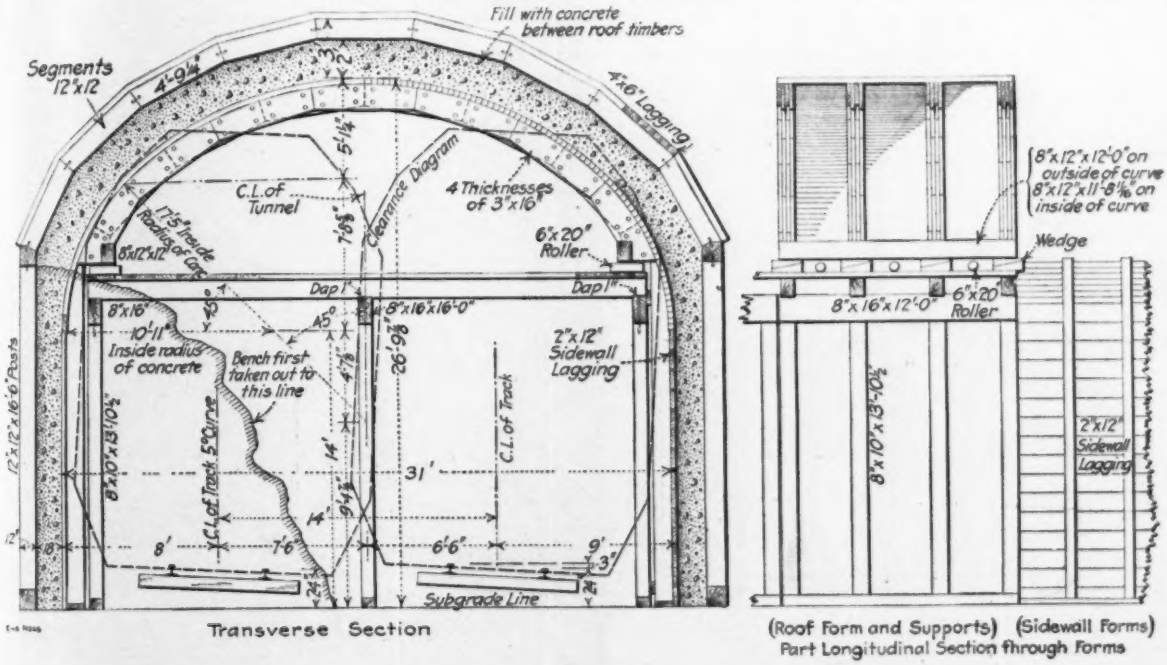


FIG. 3. DOUBLE-TRACK TUNNEL AT WINDY POINT, IN THE CASCADES; GREAT NORTHERN RY.

but in order to expedite the construction, two adits were driven from the slope of the old cut to the center line of the tunnel. These adits were respectively 415 and 994 ft. from the west portal. From the first of these the wall-plate drifts were started in both directions, while from the second adit the drifts were driven eastward only. A fourth point of attack was the west portal of the tunnel. The adits were 8x10 ft., and about 100 ft. long. Later, a third adit was started (at 1070 ft. from the west portal) to strike the bench at subgrade and facilitate the removal of the muck from the bench.

The heading was taken out in the shape of a segmental arch, having a core which was afterwards shot out with the bench. The timbering of the roof proceeded with the heading. The bench was worked from the west end and from the one adit mentioned above, giving three points of attack. All mucking in the heading was done by hand, while in the bench it was done by a power shovel; 35½ cu.yd. of rock had to be removed per lin. ft. of tunnel section, without counting the overbreak. At time limit unless the amount of mucking was reduced, it was decided to complete the heading only for full section, and to take out the bench for one track only. This could not be made narrower than about 25 ft. with the shovel, and in most cases the rock broke as far back as the wall plates (Fig. 3). The tunnel when completed had the full double-track section for about 200 ft. at each end, with single track on the intermediate 800 ft., the widening of which (on the downhill side) has been continued through the past winter.

No particular difficulties were encountered in the work, the main trouble being in handling the tunnel muck out of the adits by hand. Rock cars of 1-yd. capacity were used for this, and the muck was dumped from the heading adits either into 30 air-dump cars (which were unloaded by a work train when full) or through a glory hole under the track. The muck from the bench, which was taken out through the adit, was hauled across the track and wasted over the side of the mountain.

The west approach contained 33,000 yd. of solid rock

and this was taken out and a double-track combination snowshed was built, 450 ft. long. The method of placing concrete here was different from that used in the other combination sheds, described below. The mixing plant was set above the track and the material was handled into bins from the cars with a clamshell bucket. Sand and gravel ran from these bins into hoppers and were dumped into the mixer. A 1-yd. mixer was used and the concrete cars were handled by a hoist and an endless cable.

PROGRESS—The contract was let Apr. 15, 1913, and work on the approaches commenced May 5, while the center drift at the west portal was started June 13. The first adit was started May 13, and completed June 13, when the wall-plate drifts were started. The second adit was built June 17-30, and the third or bench adit, Aug. 7-27. The wall-plate drifts at the west portal were started July 5, and completed Sept. 14. Work on the bench was started at the west end (with steam shovel) Aug. 15, and at the east adit (by hand) Aug. 27. The tunnel was completed Dec. 15, and track was laid and trains operated on Dec. 17.

the back wall and foundations being of concrete, with timber posts and roof. Three types of construction are used, all having a concrete retaining-wall, either of gravity section or reinforced with steel bars, and all having concrete pedestals for wooden posts supporting the timber roof. Fig. 4 is a section of the combination concrete and timber shed with reinforced-concrete back wall, and shows also a section of the gravity concrete back wall.

The roof load and the slide action are taken as 900 lb. and 100 lb. per sq.ft. of roof surface. The quantity and weight of material per lin.ft. of combination snowshed with reinforced-concrete backwall is as follows:

	Per lin.ft.
Concrete, cu.yd.	3.926
Reinforcing bars, lb.	600.00
Timber, ft. b.m.	715.00
Cast-iron caps and bases, lb.	53.00
Machine bolts, lb.	20.30
Drift bolts, lb.	16.60
Cast washers, lb.	6.60
Plate washers, lb.	0.31
Angle iron, lb.	10.40

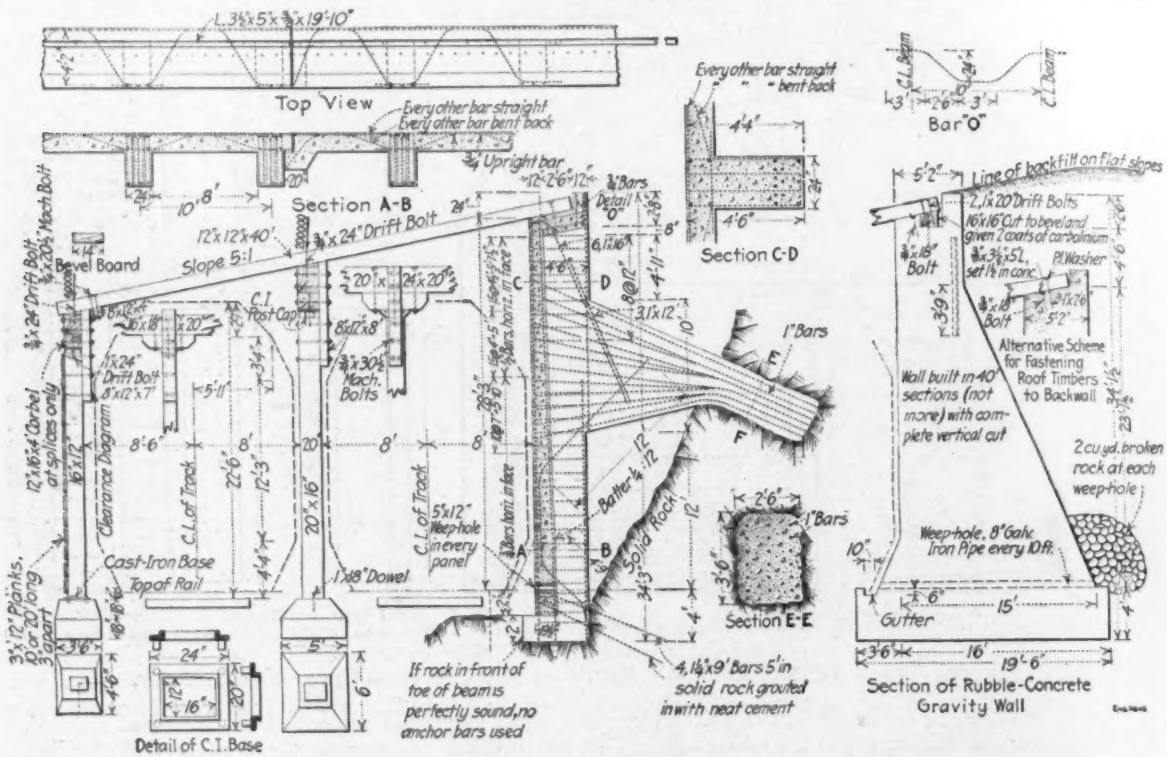

Top View
Section A-B
Section C-D
Section E-E
Bar "O"
Detail of C.I. Base
Section of Rubble-Concrete Gravity Wall
Cast-Iron Base
Top of Rail
Clearance Diagram
Bevel Board
Slope 5:1
C.I. Post Cap
C.I. of Track
Weep-hole, 8" Galv. Iron Pipe every 10 ft.
Gutter
Alternative Scheme for Fastening Roof Timbers to Backwall
Wall built in 40' sections (not more) with complete vertical cut
2 cu.yd. broken rock at each weep-hole
Line of backfill on flat slopes
Solid Rock
If rock in front of toe of beam is perfectly sound, no anchor bars used
4, 1¼"x9' Bars 5' in solid rock grouted in with neat cement

FIG. 4. COMBINATION SNOWSHEDS WITH TIMBER POSTS AND ROOF, AND WITH BACK WALL OF REINFORCED-CONCRETE OR MASS CONCRETE

COMBINATION CONCRETE AND TIMBER SNOWSHEDS

The first permanent snowsheds on the Great Northern Ry. were constructed in 1910, and were described in ENGINEERING NEWS, Dec. 15, 1910. They were of reinforced concrete, with a length of 1480 ft., while in 1911 an additional length of 982 ft. was built. While these have proved satisfactory they are very expensive.

To reduce the cost and at the same time secure practically permanent structures, the permanent snowsheds built since 1911 have been of combination construction,

The front slab and bottom slab of the reinforced-concrete retaining-wall in earth and rock section are designed as continuous beams, reinforcing steel being provided for positive and negative moments. The counterforts are designed as cantilevers. The loading of the roof surface was determined by actual measurements of some of the deepest slides and weighing the packed wet snow. The weight is taken as 400 lb. per sq.ft. It was assumed that the friction of the snow in sliding over the roof would produce a pull in the plane of the roof equal to 100 lb. per sq.ft. of roof surface. The seat for the roof timbers on top of retaining-wall has been designed therefore, as a horizontal beam to take care of this slide action.

Wherever the ground on the downhill side of the shed

does not fall off abruptly, the shed is boarded up on the open side to prevent the overflowing snow from blocking the track by backing up into the shed. In some of the sheds the six middle rows of planking are removable (beginning with the fifth from the top), so as to afford light, air and a view of the scenery in summer. They are secured by battens 3x10 in., 8 ft. long, with filler blocks between the planks, and lag screws ¾x10 in. are put through the batten and fillers into the posts.

To take care of the thrust against the outside posts, the bottom of each is set in a cast-iron frame anchored in the pedestal, while the top scab of the post butts against a longitudinal timber bolted to the roof, thereby transmitting the thrust into the ground and roof. The posts and counterforts and also the vertical beams in rock section with anchors, are set 10 ft. c. to c.

Construction Methods of Combination Sheds

On May 7, a contract was let to Guthrie, McDougall & Co., to construct double-track snowsheds at points ½ mile east of Scenic and 1 mile and 1½ mile west of Tye. The first was 1860 ft. long, and the sheds near Tye were 1300 and 780 ft. long. The shed near Scenic was new work, but the sheds near Tye were to replace old sheds and the old work had to be torn out before work could be started on the new structures. The contractors began work immediately on the construction of camps, of which they built three. One near Scenic for 350 men, and one near Tye for 300 men, with a second camp about a mile west for 80 men.

The total work involved the handling of 125,000 cu. yd. of excavation for the wall and 125,000 cu.yd. of excavation for the backfill behind the wall. There were 54,000 yd. of concrete placed. The timber used in the sheds amounted to 2,700,000 ft. b.m. All material entering into the construction of the sheds was to be furnished by the railway and delivered at the site of the work. Gravel and sand were secured from two pits, one at Richmond Beach near Seattle, and about 90 miles from the work; the other at Trinidad on the east slope of the mountains and about an equal distance from the work.

Before work could be started tearing out the old sheds, about 300,000 cu.yd. of snow had to be removed from them. This was packed very hard and considerable of it had to be shot before it could be handled. Various methods of moving it were used, including hydraulic sluicing, moving it with a derrick, and with shovels and small cars. Work started tearing out the old sheds on May 27 and excavation was started June 16, the tearing out of the old sheds being practically completed by July 10. Excavation started on the shed near Scenic on May 19. The first concrete was placed in this shed June 10 and the first concrete in the sheds near Tye was placed July 15. From June 10 until July 5 only 1000 yd. of concrete were placed, on account of the difficulty of getting suitable material. During this time, a screening plant was put in and after that plenty of gravel was available.

Fig. 5. Typical Timber Snowshed; Great Northern Ry.

As soon as the work of excavating was far enough ahead, six ½-yd. concrete mixers were put on the work. The sand and gravel were shoveled from the cars by hand and wheeled to the mixers in barrows. The mixers were set on movable platforms and were moved for every 160 ft. of wall (Fig. 1). The concrete was hoisted in skips by means of a high tower and discharged into the forms through chutes. Six mixers made as high as 1000 yd. for a 12-hr. day, and considerable delay was always encountered on account of passing trains and other delays incidental to maintaining uninterrupted traffic.

Gravel was brought from the pits by trains and delivered to the work trains either at Tye or at Scenic. Three work trains were required to handle it after it was delivered on the work, one being used at the work at Scenic and two on the work at Tye. The amount of material which was necessarily handled from the main line by the work trains made this feature of the work a very difficult one to handle. Efficient service rendered by the operating department enabled the company to deliver materials to the contractor so that he suffered no delays from this source.

In excavating for the walls and in making the backfill three steam shovels were used. Excavation on the sheds was completed Sept. 20. Backfilling was started Sept. 2 and was completed Nov. 29. The first timber was placed in these sheds Oct. 17, and it was all placed Nov. 25. The timber was placed by means of hoists and derricks similar to those used in the construction of the timber sheds described below. Fig. 4 shows the concreting and timber erection for a snowshed 1340 ft. long.

Timber Snowsheds

Two kinds of timber sheds have been built. The first type, with posts 4 ft. c. to c., has been used in gulches or wherever slides of great volume are known to occur. The second type, with posts 8 ft. c. to c., is reserved for places where the slides are less severe. In former years, when logs were plentiful along the line, the place now taken by the concrete retaining-wall was occupied by log cribs, which in most cases, did excellent service for 15 years and over. But since the timber along the mountain side along the track has been killed by fire, it has been found too costly and too bulky to haul logs, and 12x12-in. dimension timbers are used for crib construction.

In the timber shed construction, the roof extends back into the sidehill until the slope of 5 in 1 strikes the ground. Special care was taken to break joints continuously with the roof timbers and to so brace the posts, uphill from the track, as to put the braces in tension. At the same time, the construction on the downhill side, by means of an A-frame (and occasionally by using an additional post) was arranged to take care both of the slide action as well as of the back thrust produced by the piling up of the snow falling over from the roof of the shed. Fig. 5 shows the end of one of these sheds, and the construction was described in Engineering News, Dec. 15, 1910.

Construction of Timber Snowsheds

On Mar. 26, 1913, the contract for the construction of approximately 9000 lin.ft. of timber sheds was let to Grant Smith & Co. The contract covered only the labor of placing the timber and iron, and the railway agreed to deliver all material at the site. A preliminary order of 15,000,000 ft. b.m. was placed on Feb. 27, with the Pacific Fir Co. for immediate delivery. Later requisitions brought this amount to approximately 23,000,000.

The first delivery of timber was made Mar. 20, at Gold Bar, 40 miles from the center of the district where the bulk of the timber sheds were built. This was done for several reasons. At the time the first deliveries were made, there was too much snow to permit of the unloading timber on the site of the sheds, and owing to the nature of the country through which the work was being done, the slopes being very steep and in many cases precipitous, there was no room along the work for storage of timber.

The average amount of timber delivered was about 200,000 ft. b.m. per day. The contractors got on the ground Apr. 5 and immediately started to erect their camps. At this time, there was about 4 ft. of snow on the ground. Excavation for the footings for the sheds began Apr. 16 and the first timber was placed Apr. 20. From this date until May 30, while camps were being built and equipment assembled, the average timber placed daily was 45,000 ft. b.m. During this time the timber delivered was unloaded and stored at Gold Bar and a total of 7,000,000 was thus handled. This method not only served to take care of the timber being delivered but also gave a reserve supply to draw on in case the mills should be unable to turn out the required quantity later in the season.

The district covered by this work was from Tye to Scenic and was all within a distance of eight miles, with the exception of about 1,500,000 ft. b.m. which was placed in five small sheds at a considerable distance from the site of the main work. From Tye to Scenic, there were 29 separate sheds. o Thandle this work, the contractors built four camps capable of caring for from 100 to 300 men. During the height of the season, from 600 to 700 men were engaged. The contractor's equipment consisted of 15 hoisting engines of 25 hp.

Where the shed to be constructed was an extension of an old shed, the hoist was placed on the old shed and an A-frame derrick with a boom from 60 to 70 ft. long was built. The timber for the construction of the shed was unloaded from the cars at the site, picked up by the derrick and placed in the structure. When 40 to 50 feet of the shed had been built, the derrick was moved ahead and the operation repeated. Owing to the very limited amount of storage space there was never enough timber on the ground for more than two days' work and great care was necessary in delivering timber so as to keep the derrick working uninterruptedly without interfering with the operation of trains.

Where an entirely new shed was to be built, the first 40 or 50 ft. was stood up with a car derrick and then the hoist was set on top and the operation continued as above. In connection with the construction of the timber sheds, a considerable amount of very expensive excavation was necessary in order to secure footings for the posts and foundations for the cribbing. This amounted to about 6 yd. per lin.ft. of shed, and 60% of this was rock.

On account of the different natural conditions encountered, the plans furnished could only be general in character and the type of shed built depended largely on the foundation secured. This prevented any large amount of timber being framed ahead and required most of the framing to be done on the site of the shed. The very limited space and the congested condition made this slow and expensive. Timber was handled by hauling trains to the division point at Skykomish, the foot of the 2.2% grade, and from there the timber was handled by work trains. Two work trains were kept very busy. On account of the steep grade, it was necessary to keep the engine on the downhill side of the loads at all times and when a car was spotted for unloading or for any other purpose, it had to be very securely blocked and chained

to the rail. No accident of any sort happened through the handling of the material.

From June 10 to Sept. 10, the amount of timber placed daily was very uniform, averaging over 180,000 ft. b.m. After Sept. 10, the rate fell off, as portions of the work were being completed and equipment was being taken off. By the first of October, the work was practically completed, although a small amount of timber was placed after that date. In connection with the timber sheds, there was a great amount of repair work done on the old sheds. About 1,500,000 ft. b.m. was used in this work and approximately 20,000 days of labor.

State Aid to Irrigation Farmers*

By Elwood Mead†

For the past seven years I have had the privilege of working for a government that has shown great wisdom and sagacity in its social and industrial legislation. Nowhere has this been more conspicuous than in its land and water laws and the policy followed in irrigation development.

The absence of adequate financial help for settlers, during the first five years, is the main cause for the stagnation in irrigation development in the United States. One only needs to put himself in the place of the settler to realize what a costly and serious venture it is to attempt to transform unimproved land into an irrigated farm and how much danger there is to the man of small capital that the attempt will prove a disaster. Before the settler can have any return from his land, a house must be built, ditches dug, land cleared and graded, seed sown and the somewhat difficult art of irrigation mastered under untried conditions. While this is being done there is no income. His scanty capital is being swallowed up in living expenses. Often there is much hardship for himself and his family. Many a poor settler's wife has aged ten years in ten months. With water rights costing from $40 to $60 per acre, and with the present western interest rates, the chances are all against the success of the settler who has less than $5000 to $6000 capital.

Adequate financial aid for settlers during the first five years is the greatest question before this Conference. As Chairman of the State Water Commission of Victoria I have assisted during the past five years in carrying out one of the most complete schemes of state aid to irrigated settlement ever attempted. Its success will, I hope, encourage this country to adopt a similar policy.

Seven years ago the situation under the irrigation schemes of Victoria was not unlike that under the Reclamation and Carey Acts projects today. Canals were built, water was available, but settlers were not there to use it and hence the works were unprofitable. The State Government determined to change this by creating conditions which would enable anyone who had industry and thrift to secure an irrigated farm even if he had little or no money, and which would warrant its inviting settlement from distant countries. It has succeeded in its purpose by requiring only small initial payments and giving adequate aid and direction. No charge is made for water rights and the annual payments for water are only intended to cover 4% interest on the cost of works and the expenses of operation and maintenance. The cash payment on land is only 3% of its cost and 31½ years is given in which to complete payments with interest at 4½%. Houses are built for settlers on a cash payment of about one-fourth the cost, payments of the remainder may extend over twenty years with 5% interest.

The state, when desired, grades and seeds a portion, up to one-fourth, of each farm, on the payment of one-fifth the estimated cost and allows the payments of the remainder to extend over ten years. It employs disinterested expert advisers to help the settler select his farm, buy his horses and cows and do what is needed to get established on his farm. The saving in money and time which this system effects can only be appreciated by those who have seen it in operation. Many settlers select their farm and arrange for the erection of their house before leaving Europe; are able to go directly from the ship to their new home, and have a living income from a dairy herd within a month from their arrival.

The state follows up this initial assistance by loaning the settler 60% of the value of any improvements he makes. This enables men with small capital to complete without delay the grading, seeding and improvement of their farms. The settler does not need to halt when he exhausts his own capital. When he has one field graded he can borrow money on that to grade another.

This generous aid and the thoughtful consideration for his welfare is a great encouragement and incentive to the ambitious and earnest beginners. I have never seen elsewhere men work as hard or achieve as much in the first two years as on those Victorian settlements. But all who come are not industrious or capable. Such a scheme is especially attractive to the visionary and incompetent. Some of the settlers seem to regard the house, the farm and the graded fields as an endowment, and to believe that the state which has done so much to help them succeed will do the remainder.

To help the inexperienced and guard against being imposed upon by the idler or indifferent, the state employs in each district a tactful, practical farmer who is the friend, counsellor and adviser of the working settler and a stimulator to others. When his efforts and influence fail the fact is reported to the head office. The settler knows of this and also knows that such report will have a controlling influence in determining whether or not he is to obtain loans or be given sympathetic treatment when payments are delayed. The law is so framed that the commission administering it has discretion to defer payments where settlers are unfortunate, but it also has authority to eliminate promptly any settler who fails to show earnestness, industry and thrift.

This scheme of comprehensive aid has now been in operation for six years. The settlements that are three years old are practically established and self-supporting. It is the unanimous opinion of all those familiar with development that nowhere else have they seen such rapid progress in the cultivation of land or such large returns in the earlier years of settlement. One of the inspectors was formerly a successful farmer in the Imperial Valley, California. It is his belief that as much progress is made in these settlements in Victoria during 18 months as was made on an average in the Imperial Valley in five years.

While Australia and New Zealand have led in the movement to aid settlers, their example is now being followed in other developing countries. South Africa has adopted it and the newspapers report that British Columbia intends to adopt it. The Canadian Pacific Ry. is loaning each settler on its irrigated tracts in aid of these initial improvements, and the Argentine is beginning to consider making such aid a feature of its colonization policy.

The adoption of a similar policy in the United States would relieve settlers of much anxiety and hardships without imposing any burden on the taxpayer. By using the public credit, long terms for repayment could be obtained at low rate of interest, and with settlers fitted for their work and given practical advice by the Government, repayment of loans would be assured and development would then continue under opportunities as favorable as those provided in other countries. Every condition that has secured the success of state aid in Australia exists here in equal or greater measure. The tenant farmers of the Middle West furnish a large body of the very best class of settlers.

The greatest need in this country is the complete use of the works already built. From Colorado to California are private and public irrigation works, with less than half the land under cultivation, and with inadequate revenues are struggling to maintain their financial credit. Suitable settlers would completely change the situation.

Under some of these schemes the conditions for extending this aid are altogether satisfactory, while under others, settlement under present conditions should be prevented. Either the water supply is inadequate, the land is unfit, or the charges for land and water are too high. To extend public aid in the settlement of such enterprises means inevitable disaster to all concerned, and the first step in all such cases should be an investigation by some competent public authority, to weed out the sound from the unsound schemes. Starting with sound enterprises, there should, in each case, be an organization to meet and take charge of the settlers, and there must be some way by which large sums of money can be provided to give them the necessary aid.

In the state of Victoria this money is provided in a large measure by the State Savings Bank, which has deposits of $110,000,000, on which 3% and 3½% interest is paid. This money is loaned directly to the farmers at 4½% and 5%. A remote country, with small accumulations, thus gives the farmers money at about half the interest rates prevailing in the western part of the United States. It would seem that the Victorian policy might wisely be followed in the United States.

*From an address delivered at the Irrigation Conference at Denver, on Apr. 9.

†Chairman, State Rivers and Water Supply Commission, Victoria, Australia.

A Reinforced-Concrete Truss Bridge, Las Vegas, N. M.

By George E. Morrison*

The highway bridge recently completed across the Gallinas River between the town of Las Vegas and the City of Las Vegas, New Mexico, contains in its design and method of erection some points of special interest. It consists of four reinforced-concrete truss spans, each 40 ft. from center to center of bearings, with a 16-ft. clear roadway. Each span is made up of two trusses, cast as separate members and lifted into place, carrying floor-beams, also cast separately and placed in slots provided in the truss posts, with a reinforced-concrete floor slab poured into forms hung from the floor-beams. The bridge is a through structure, so the trusses form the railing. The roadway consists of a reinforced-concrete slab with a bitulithic wearing surface.

The plans and specifications for the bridge were submitted by the contractor and were subject to the approval of the State Engineer of New Mexico, and of the writer acting as engineer for San Miguel County.

The bed of the Gallinas River consists of coarse sand and gravel overlying a stratum of hard shale. During the fall and winter season, the surface flow of water is insignificant; but there is a very heavy flow throughout the coarse gravel bed, and during the spring and summer the surface flow makes a river of very respectable size.

The pier and abutment foundations consist of 5-ft. square pedestals, sunk from low water through the gravel bed and about 12 in. deep into the shale bedrock. Above the low-water line, each pier consists of a pair of truncated cones connected by a 12-in. concrete web. The cone-shaped pedestals are 3 ft. in diameter at the top and 4 ft. at the water line with span rests 6½ ft. above low water. The abutments show the same cone-shaped span rests in front but with counterforts behind the span rests and at the ends of wing walls. The web and wing walls of abutments are 12 in. thick and extend to 5 ft. below low water. The walls are designed as slabs spanning the distance between the counterforts and the reinforcing is proportioned to hold a fluid of 30 lb. weight per cu.ft.

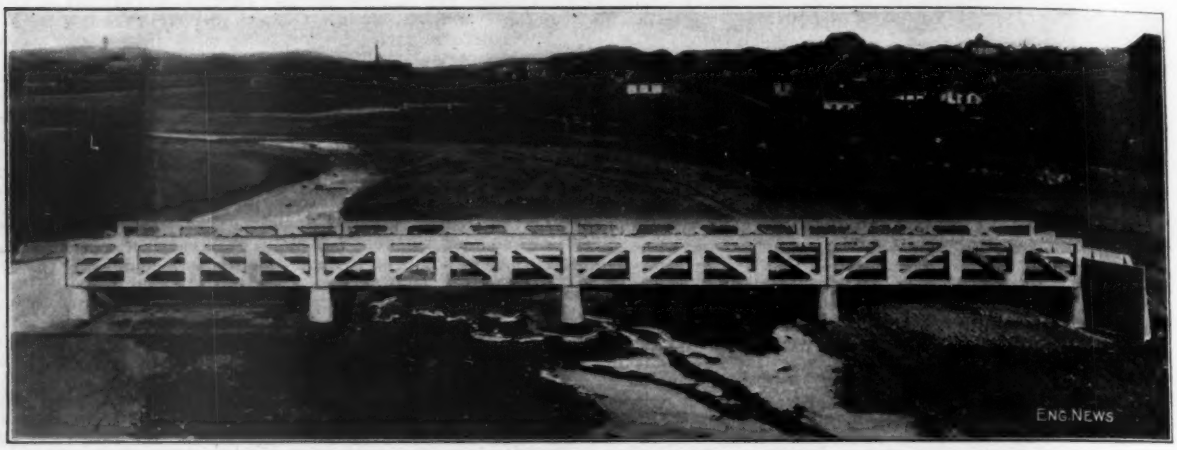


Fig. 1. Reinforced-Concrete Truss Bridge across Gallinas River, Las Vegas, N. M.
(Separately molded trusses and floor-beams.)

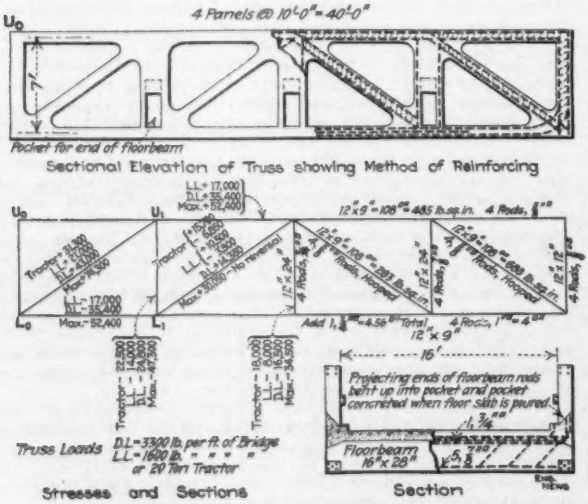

4 Panels @ 10'-0" = 40'-0"
Pocket for end of floorbeam
Sectional Elevation of Truss showing Method of Reinforcing
Truss Loads DL = 3300 lb. per ft. of Bridge
LL = 1600 lb. " " "
or 20 Ton Tractor
Stresses and Sections
Projecting ends of floorbeam rods bent up into pocket and pocket concreted when floor slab is poured.
Floorbeam 16" x 28"
Section

Fig. 2. Details of Las Vegas Bridge

Both the floor slabs and the trusses were designed to hold a load of 100 lb. per sq.in. or a 20-ton tractor in any position on the roadway. In the tension members of the truss (bottom chords and verticals) steel was provided to take the entire stress at 16,000 lb. per sq.in. All steel used was plain square bars of medium steel with an elastic limit of 33,000 lb. and an ultimate strength of 55,000 to 70,000 lb. All compression members have a ⅝-in. square rod in each corner and these rods are closely hooped with No. 9 wire, but the area of steel is not figured and the maximum unit compressive stress is 688 lb. per sq.in. of gross section of concrete. This stress occurs in the end posts only and can only be caused by the combination of the dead load stresses and that due to a 20-ton tractor placed as close as possible to one truss. The distance between nominal pin centers was taken as the theoretical length on compression members and in members where the unit stress was not the governing consideration, the least dimension was arbitrarily fixed at $^1/_{20}$ of the theoretical length. The actual unsupported lengths were really much less than the theoret-

*Civil Engineer, East Las Vegas, N. M.

ical lengths. The steel in compression members was figured only to take the bending stress caused by the method of erection. In order to avoid a concentration of stress in the corners of the ends of floor-beams where they rest in the pockets in the trusses, bearing plates are provided to reduce the bearing to 350 lb. per sq.in.

The trusses and floor-beams were separately cast upon molding platforms on the ground and afterward lifted into place. The heaviest piece lifted was one complete truss weighing approximately 9 tons. Each floor-beam weighed about 4 tons. Both trusses and floor-beams were figured for erection stresses. The forms for the floor-slab were supported by U-shaped rod hangers across the floor-beams and the floor-slab cast in place. Thus no falsework was required for any of the work. No laterals were used, as the floor-slab for each span is monolithic and is so bonded into the trusses at the panel points as to rigidly connect the trusses and to eliminate the necessity for laterals.

Forms were provided so that two trusses and three floor-beams could be cast at the same time. Thus each superstructure form was used four times on the job. All forms received two heavy coats of "saw oil" before being used the first time and another coat before each subsequent use. The pier and abutment forms were built in sections to be easily handled; the pier form being used three times and the abutment form twice.

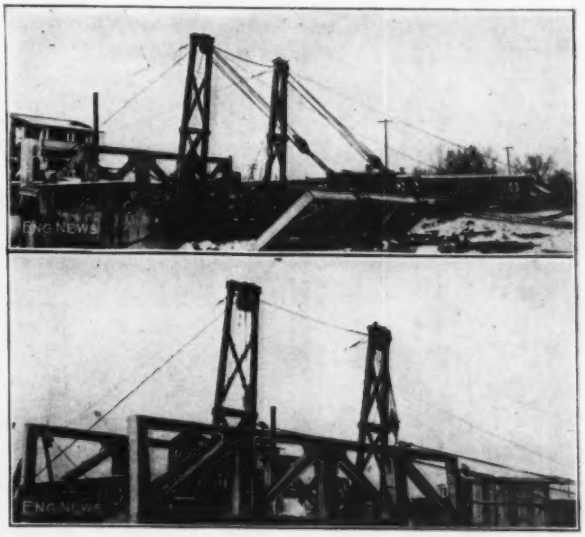
The molding platform had an exact outline of the truss laid out upon it (Fig. 3). The previously bent reinforcing was assembled, wired and wrapped very rigidly into place, then the forms were placed and blocked solidly into position. The reinforcing was held up from the platforms and kept from side forms by small blocks of concrete. This course permitted the reinforcing to be assembled and wired with an ample platform to work upon and no interference because of small space between forms.

All concrete was mixed by hand; that for the substructure being 1:3:5 mixture using the sand and gravel at the bridge site; and that for the entire superstructure being a measured 1:2:4 mixture with no stone larger than 1½ in. At the time of letting the contract, it was considered that the sand and gravel at the site could be used for the entire work, but when the superstructure was started, it was found that the cost of screening out all stone over 1½ in. made the price of the useful material prohibitive, and the contractor, therefore, hauled a finer gravel two miles for the entire superstructure.

The forms for trusses and floor-beams were removed about seven days after casting and the first truss was lifted into place 10½ days after casting and the average time between casting and raising for the whole eight trusses was about 12 days. During the progress of the work, some very cold weather was experienced, the thermometer showing as low as 14° below zero at night. During this period two trusses and three floor-beams were entirely covered by tents and heated by oil stoves. Watchmen were on duty all the time, and the thermometers at the corners of the tents held above 32°.

The floor slab has a crown of 1-in. from side to side and there is a rise of 1½ in. from each end of the bridge to the center. Drainage through the floor was provided for by casting in oiled, tapered wooden plugs, small end up. These were driven out when the floor forms were removed. The sections of the reinforced-concrete hub guard were separately cast and bolted to the truss switch ¾-in. anchor bolts. There is a drain hole in each gutter in the center of each panel.

FIG. 3. REINFORCED-CONCRETE TRUSS ON MOLDING BOARD



FIGS. 4-5. ERECTING THE LAS VEGAS BRIDGE TRUSSES

The floor on each span is continuous, but over each pier a 1-in. expansion joint is provided, the 1-in. space being filled with bitumen. Expansion of the trusses is provided for by sliding plates which give a bearing stress on the concrete under full load of 340 lb. per sq.in.

Members L^0U^0 and U^0U^1 are, of course, redundant as far as truss action is concerned but were used in order to give an unbroken profile throughout the length of the bridge, and also because by running the bottom-chord tension bars up into L^0U^0 it was easy to relieve them of their stress.

The stresses of this bridge are easily determined; the method of assembling and wiring the truss reinforced into position on a platform before there are any forms in the way permits an easy inspection of the work and also insures that the bars will be placed correctly and will remain in that position; the elimination of falsework removes one very large item of cost and also of danger in case of streams subject to sudden freshets; longer spans may be used than is possible with ordinary girder types and in cases where there is but little headroom between the high-water mark and the level of the roadway, as

there was in this particular instance, this type of construction gives more waterway than could be obtained with the arch type of bridge.

The contractor for this work was the Missouri Valley Bridge and Iron Co., of Leavenworth, Kansas, the plan being designed and executed by the company's western agency at Denver, Colo., under the supervision of the writer. A patent has been applied for covering this design and method of erection. The contract was signed Sept. 22, 1913; active field work was started Oct. 8, 1913, and the bridge was accepted Feb. 10, 1914.

Building a Group of Circular Concrete Ore Bins

By M. F. Sayre*

A set of four reinforced-concrete ore bins have recently been completed as a part of the ore-concentrating plant for the Croton Magnetic Iron Mines, Brewster, N. Y.

This mine is a steam-shovel proposition, and the mining machinery and jaw crushers, taking the ore down to 1½-in. size, are to have capacity sufficient to treat the entire daily output in one shift. The fine-crushing and concentrating plant will be run two shifts daily so that these ore bins are needed to equalize the feed to the mill, and to provide storage against occasional shut downs of the mine or mill. These bins are each 22 ft. 6 in. inside diameter and 34 ft. 3 in. above foundations, giving an effective capacity of 390 cu.yd. or about 500 tons apiece.

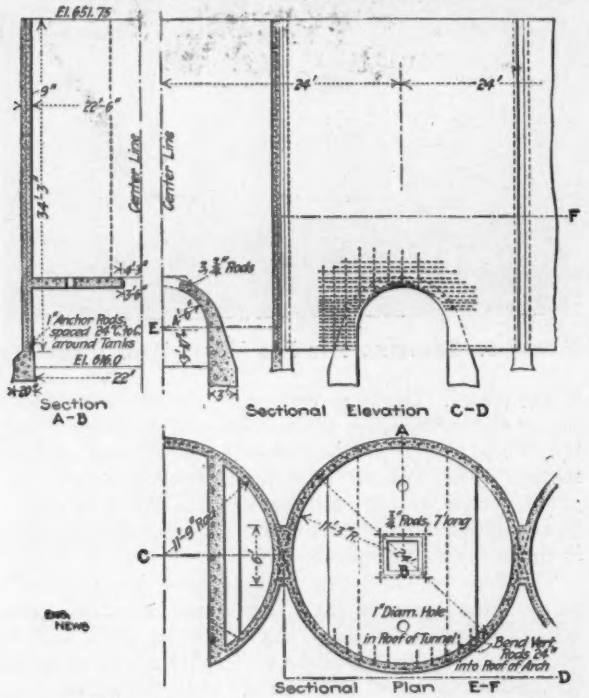


Fig. 1. Details of Concrete Ore Bins at Brewster, N. Y.

Ore feed is by an inclined belt conveyor from the coarse-crushing plant, delivering at the center of the first bin, directly to the first bin and by another belt conveyor with tripper, running along the center line of the bins, to the other bins. The ore is withdrawn through hoppers, automatically feeding to belt conveyors running in the arched tunnels under each bin, which carry it to the fine-crushing plant, located 40 ft. farther down the hill.

The bedrock, a mica schist decomposing somewhat readily on exposure to the air, lay close to the surface, and the ore bins were founded on this. No reinforcement was used in the foundations, but 1-in. round vertical rods, 2 ft. long, were placed 2 ft. apart to bond the footing to the 9-in. exterior wall forming the upper part of the ore bins. This 9-in. wall was reinforced vertically by ½-in. round rods, 18 in. apart, and horizontally by cables placed 4¼ in. apart for the first 5 ft., then 6 in. apart for 10 ft., and 9 in. apart for the remainder.

The original design called for ¾-in. and ½-in. round rods; but the second-hand ¾-in. wire cable could be obtained locally for much less and was substituted. The strength below elastic limit was as high for the cable as for the rods, even allowing liberally for wear, and the cable could be handled more readily than the rods and used in longer lengths, giving fewer laps. Any badly worn sections of the cable were used in the upper sections of the bins, where only ½-in. round rods were called for. The cables alternately circled each bin separately, and made figure eights inclosing all four bins to bond them together. The vertical rods could not be handled full length and were lapped 2 ft. at joints. The cables were cut long enough to encircle one bin, lapped 3 ft. or more at joints, the ends raveled out to give better hold in the concrete, and then the two wires clamped together by a wire clip.

The wire cables used cost actually $75 delivered, as against an estimated $520 for the round rods.

Forms—Fig. 3 shows the forms. They were made of rough 2-in. unseasoned chestnut lumber, except the lagging on the arches, which was 1¼-in. chestnut.

The ring forms, 4 ft. high, were composed of face boards not over 12 in. wide nailed to two ribs, and were made in four types: Type A—inside ring forms 8 ft. 3 in. long; type B—outside ring forms 8 ft. long; type C—outside closure forms 2 ft. 6 in. long, needed to keep the corresponding outside and inside forms opposite each other; and type D—the V-forms at the junction between the bins on the outside ring. Two rows of ½-in. bolts held the forms together—six bolts in all for each 8-ft. section, long enough to pass through vertical bolting pieces, 2x4 in. x 3 ft. 6 in. long, placed outside the ribs.

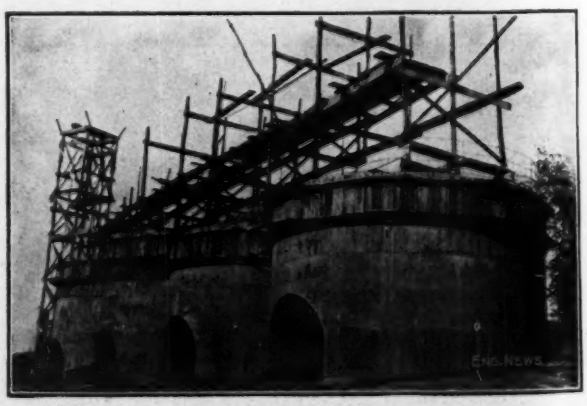


Fig. 2. View of Ore Bins during Construction

*Engineering Dept., Central R.R. of N. J., Mauch Chunk, Penn.

The ribs were wide enough to stand on and the reinforcement and these two-by-fours gave sufficient handholds so that no outside scaffolding other than ladders proved necessary.

Construction

After the foundation concrete had set, the ring and arch forms for the first 4-ft. rise for bins 1 and 2 were placed and concreted. The arch forms were then built up to the full height of the arch, the ring forms raised, the gap between them and the forms for the back of the arch filled in, and this lift concreted. As soon as this had set, the arch forms were removed to be reused for the other bins. Above the arches, the four bins were carried up simultaneously. In raising the form a block and tackle hung from a long pole running across the scaffolding was used. The forms were raised in the order indicated by the Roman numerals on the sketch, two forms at a time being raised by each gang, and two gangs being used. The cable reinforcing was placed for one lift at a time before raising the forms. For the first two lifts the forms were raised 2 ft. 9½ in. each time so that the lower bolts came in the holes just vacated by the upper bolts. Driving the bolts wasted a good deal of time and the other lifts were made 3 ft. 1 in. each, placing the lower bolts on top of the concrete each time, occasionally checking up the elevation of the concrete to keep the top from getting too far off level.

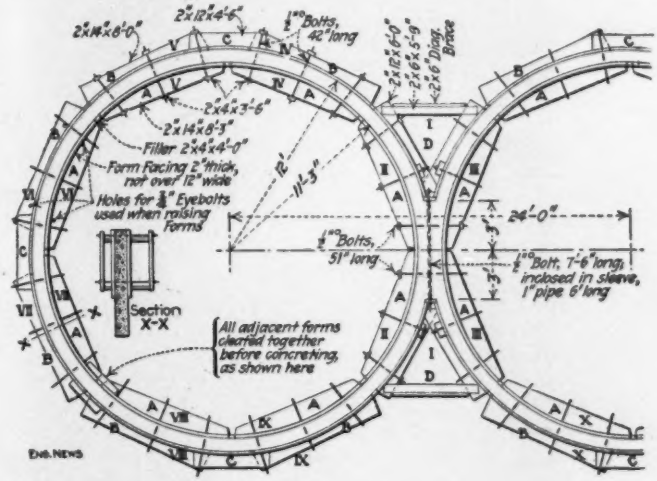


Fig. 3. Details of Forms

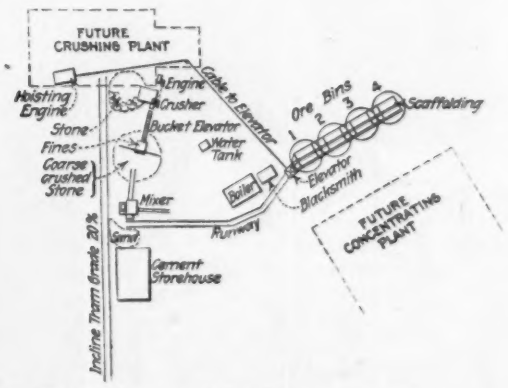


Fig. 4. Layout of Temporary Plant for Construction of Ore Bins

Equipment—The elevator was run by a long-suffering double-drum hoisting engine located at the crest of the hill (Fig. 4), which also handled the incline tram, up which all supplies were brought, the derrick which handled the excavating and concreting at the site of the main crushing plant, and the small incline tram which brought the concrete from the mixer to within reach of this derrick. Thanks to a good engineer, there were no delays on this score.

Two 6-cu.ft. carts were used to carry the concrete from mixer to forms. These were loaded only half full, but at that were all that one man could handle, and smaller, lighter carts would have been advisable.

Mixing was done in a $\frac{1}{10}$-yd. batch mixer, run by gasolene. Each batch was a cart load. The concrete gang comprised one man handling rock, one man handling sand, one man handling cement and water, and dumping the mixer, two men on carts, two or three men tamping, one foreman, one engineer, one fireman. Each man was working very nearly to full capacity all the time and a larger mixer would have given no better economy. Each rise of the forms after the arch had been passed, held 25.5 yd. and took 10 to 11½ hours to fill.

The mixture used was 1:3:6 for the foundations and 1:2:4 above. At the start, only 1-in. stone and smaller was used in the concrete for the 9-in. walls, but it was later found that after forming a soft bed by dumping several barrows of the fine concrete into the bottom of the form, a coarse aggregate up to 2½-in. size stone could be used, careful tamping, of course, being necessary. Under local conditions this reduced the cost considerably.

Cost—These bins cost, after crediting for the future value of the form lumber used,

For foundations—221 cu.yd. at $3.81	$842.61
Above foundations—380 cu.yd. at $9.76	3710.28
Total	$4552.89

This includes labor and material used (lumber and reinforcement included), but does not include cost of excavating or charges for superintendence or depreciation of plant.

The bins were designed by Hamilton and Hansel, Consulting Engineers, of New York, and erected under the supervision of the writer and Mr. Theodore Earle, General Manager.

Preliminary Investigations, Construction Sluicing and Core Sampling at the Somerset Dam

By J. Albert Holmes*

Some general notes on the construction of the large earth dam at Somerset, Vt., were published in Engineering News, Dec. 25, 1913. This was the largest work of this sort in the East and one of the large jobs of the whole country. As the sluicing operations were notable and the core sampling unique, the writer has felt that further discussion of these features would be of interest to engineers

It will be recalled that this dam forms a power-storage reservoir in the headwaters of the Deerfield River. It is 2100 ft. long on the crest and has a maximum finished height of 106 ft. It was started in September, 1911, and finished in December, 1913, one million cubic yards having been placed. The material was excavated by steam shovels working in the hillsides beyond each end of the dam, the fill being hauled by narrow-gage dinkey locomotives and dump cars.

Geological Exploration—Material under the dam and in the borrow pits was investigated by means of test pits and borings, 150 pits being dug. On the dam-site four were carried to a maximum depth of 44 ft.; later five others were supplemented by going into bedrock with a well drill, taking dry samples.

The geology developed is shown on Fig. 1. Bedrock of the region is gneiss, a granite originally, but mashed up by pressure. The drift is unmodified or unstratified. It contains some quartzite boulders, and many boulders of unaltered granite, of gneiss, and of schist. There are also gravels, sand and clay. The sand occasionally occurred in pockets of no great extent; the clay contained boulders and small rounded stones down to bedrock. The characteristic color of the upper portions of the drift was yellow—the result of oxidation, either by exposure or leaching. Next below, the material shades through gray to the blue of the unoxidized clay overlying ledge.

Granite (rich in silica and alumina) and its various derivatives prevail here in drift and ledge; therefore, it

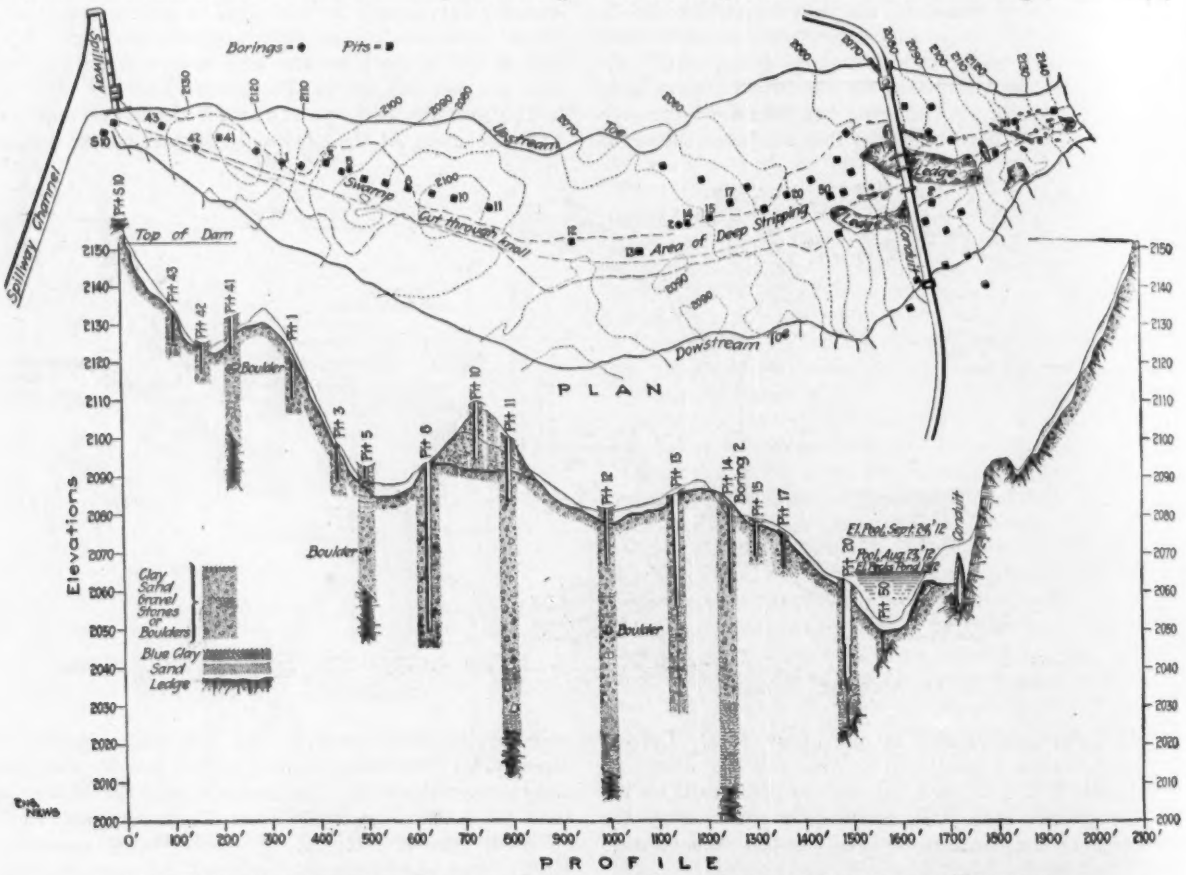


Fig. 1. Plan of Somerset Dam and Section of Site, Showing Geological Features

may be assumed that the clay is a true clay (hydrous aluminum silicate rock dust).

The lowest point at which bedrock was encountered was 75 ft. below original surface, and 400 ft. west of and 43 ft. lower than the river bed; the rock came close to the surface at both east and west ends and was exposed in the form of a ridge at the base of the east slope of the valley, the dam being so located as to bring this ridge in its center line and also to include two knolls west of the river, making, to take advantage of these natural features, 671 ft. of the 6° curve with tangents of about equal length at each end, the total length being 2100 ft.

Seepage Investigations—All pits were investigated for seepage into and from the ground, a special investi-

*Civil Engineer, 16 Chapel St., Somerville, Mass.

gation being made of inflow near the river bottom (Pit. 20). Here the material was a very compact blue clay; at depths of 8 to 12 ft. below the water surface of the adjacent pond, seepage into the 16x16-ft. pit amounted to from 70 to 100 gal. per hr. Pit 10, 5.5x7.5 ft. and 13.6 ft. deep, located on a knoll at Elev. 2110, was investigated for outflow. At 4 ft. below ground surface, the seepage into the ground was found to be about 700 gal. per hr.; at 9 ft. below, it was about 60 gal. per hr. As a result, the knoll was trenched about 18 ft. to compact material. The material in the top of the second knoll was similar to that at pit 10, but as it lay 20 ft. higher and would have that much less head, it was not thought necessary to trench.

All borings were investigated for seepage into and from the ground, each layer of sandy material being tested separately. The rate of flow out of these sand pockets ranged from 25 to 95 gal. per hr. and the amount that could be returned to the sand, ranged from 4 to 13. The water-bearing strata in all cases were overlaid by a considerable depth of clay and the accumulated water always stood higher than the adjacent pond or pool surface, showing that there was no connection therewith. Neither sand nor water was encountered in boring No. 2, taken in the deepest part of the submerged valley; the bottom was in blue clay, not boulder clay.

MATERIAL FOR FILL—The material under the dam-site and in borrow pits was of similar character and composition and was found to be in about the following proportions: Clay 20, sand 40, gravel 30 and stone 10, parts. Samples taken from four test pits on the dam-site gave the following percentages retained on standard screens:

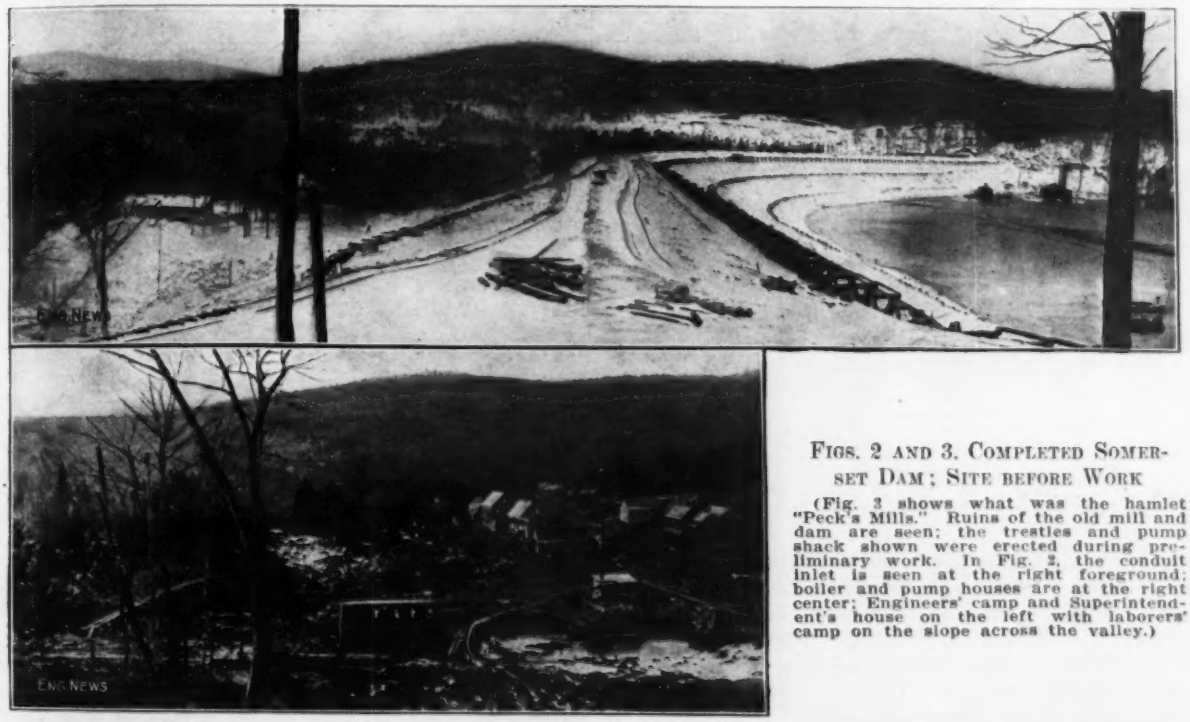
Average on No.	6,	34.5 (range 21.2 - 54.1)
Average on No.	20,	6.8 (range 4.7 - 7.8)
Average on No.	30,	2.1 (range 1.5 - 3.2)
Average on No.	50,	4.4 (range 2.0 - 6.7)
Average on No.	100,	9.6 (range 5.8 - 14.1)
Average on No.	200,	9.7 (range 6.0 - 13.3)
Passed	No. 200,	32.9 (range 18.7 - 44.7)

Screening tests were made on two samples from each borrow pit; the results are given below:

Mean on No.	10—18.6 West Pit,	11.5 East Pit
Mean on No.	20— 4.5 West Pit,	1.8 East Pit
Mean on No.	30— 5.0 West Pit,	3.0 East Pit
Mean on No.	40— 2.5 West Pit,	2.3 East Pit
Mean on No.	60— 4.1 West Pit,	3.7 East Pit
Mean on No.	80— 1.4 West Pit,	2.0 East Pit
Mean on No.	100—16.4 West Pit,	12.2 East Pit
Mean on No.	200—15.5 West Pit,	13.2 East Pit
Passed	No. 200—32.0 West Pit,	50.3 East Pit
Per cent. loss by burning		1.05 West Pit, 1.61 East Pit

These figures do not take into account large stones and boulders, but only materials in which the stones and boulders were embedded. All went into the dam, the larger boulders after being blasted. Top soil was not removed.

EARLY CONSTRUCTION—The conduit, at the base of the east slope, is founded almost entirely on rock; it has a horse-shoe section 12 ft. wide, 11.5 ft. high and an area of 112 sq.ft. It was designed to carry the maximum flow of the river during construction of the dam. Under the middle third of the dam, where the load is greatest, the arch has a crown thickness of 26 in.; above the arch thickness is 22 in. and below 18 in. Within the middle sixth of the dam are three cutoff walls crossing the conduit and connecting with the ledge. To determine the water pressure and slope through the completed dam, a number of pipes were placed in the arch of the conduit and capped on the inside.



FIGS. 2 AND 3. COMPLETED SOMERSET DAM; SITE BEFORE WORK

(Fig. 3 shows what was the hamlet "Peck's Mills." Ruins of the old mill and dam are seen; the trestles and pump shack shown were erected during preliminary work. In Fig. 2, the conduit inlet is seen at the right foreground; boiler and pump houses are at the right center; Engineers' camp and Superintendent's house on the left with laborers' camp on the slope across the valley.)

DAM FOUNDATIONS—The foundation of the dam was prepared by first removing trees, stumps and structures over the whole area. In the river bottom and about the conduit, all loose material was removed from the middle third of the base down to ledge or impervious material—in this case clay. The seams in all exposed ledge were grouted and pointed. The cut through a knoll previously mentioned, was made with 20-ft. bottom width and a swamp just beyond was cleared of mud and boulders.

The remainder of the foundation was stripped for a width of from 40 to 100 ft. to a depth of from two to five ft., the area of deep stripping is indicated on Fig. 1. The river bottom, however, could not be stripped until the dam was started and flow diverted through the conduit.

Beginning the Dam—Construction of the dam proper began with the timber trestles 1 and 2, Fig. 2. From trestle 1 a rock fill was made in the river bottom and covered with an earth blanket, turning the flow through the conduit and laying the river dry between trestles. Leakage through the upper dike after sluicing the blanket into place (about 1 sec.-ft.) was discharged by a ditch through a gap in the lower dike.

After stripping the river bottom, test pits were dug in the clay, some of them down to ledge. A ditch was excavated along the center line of the dam to further expose the nature of the underlying material. Then the gap in the lower dike was closed and both dikes widened by throwing track from the trestles toward the center of the dam. In Fig. 2, dike 1 is marked "10, 9, 8, 7, etc.," and dike 2 is marked "9, 8, 7, etc.," indicating that dike 2 was completed nine months and dike 1 ten months after dumping began.

Sluicing Plant—The first season's sluicing plant, comprising three 50-hp. boilers, one compound duplex plunger pump and one duplex piston pump, was located at the edge of the pond. For the second season one boiler and a second compound duplex pump were added.

The boilers were installed at Elev. 2111, to permit of storage in the reservoir. The pumps and house were placed on a crib sliding on three rails of a heavy timber incline (see Figs. 5 and 6). Delivery was at 150 to 175 lb. through 6- and 4-in. spiral-riveted pipe lines; this was in 30-ft. flanged lengths, tarred inside and out. Lines were laid along the dikes, or on the outside of each trestle in turn, and carried across the width of dam on towers and poles. Valves for hose connections (3-in. 50-ft. lengths) were placed at 90-ft. intervals and other valves provided for cutting out parts of the line not in use, to reduce leakage. Wear on hose was very hard; a special seven-ply cotton-covered hose gave the best service and longest life. The nozzles (1⅜-in. opening) were attached to a short section of 3-in. pipe swiveled on a movable frame (Fig. 7). Three men were required to shift and operate each hose line.

Sluicing into the center of the dam began on July 17, as soon as the gap in the lower dike was closed, and from the lower dike, close to trestle 2. Conditions at the end of July, 1912, are shown by the line between sections 9 and 10, Fig. 4. The surface of the water in the pool at the same time reached the elevation marked "9." The limits of successive months' work are indicated by lines sloping to the center of the dam and the numbers, up to 25, indicate progress by months from the time dumping began. Pool elevations at the end of each month's work are indicated on Fig. 4 by numbers corresponding to the progress for that month. Pool depth is shown between surface elevation and proper progress line. This depth ranged from 3 to 20 ft., the first deposit of fine material taking place in a wide and deep pool.

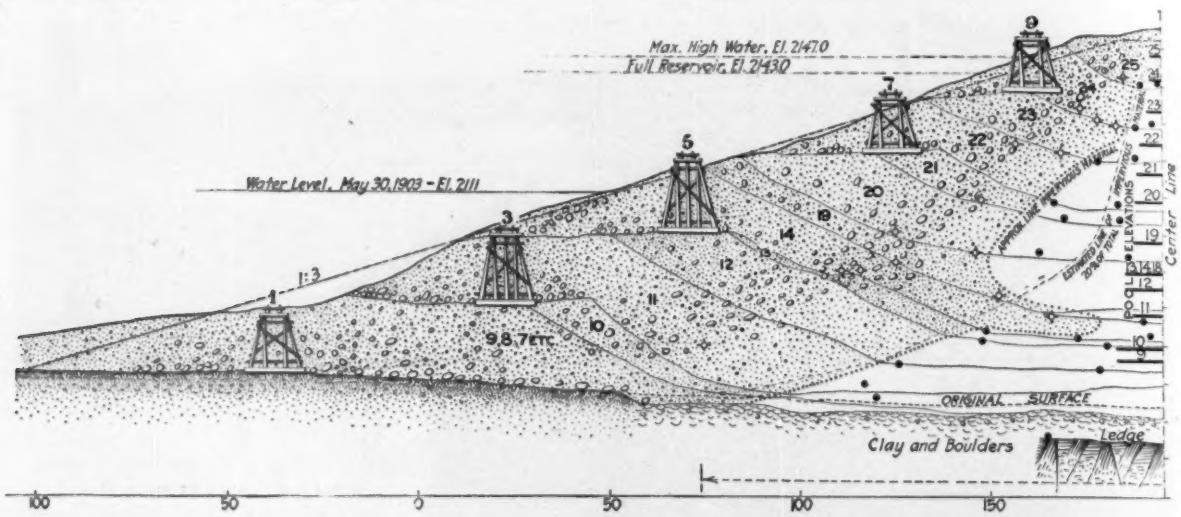


Fig. 4. Maximum Section through Million-Cubic

When sluicing began from dikes 1 and 2, the sluicing faces were about 340 ft. apart. At the end of two weeks, this distance had been reduced nearly 100 ft., but with fairly constant sluicing very little material had been carried to the center of the pool. As the pool became narrower, quite as great, and at times a greater, depth of material was deposited in the center of the pool as on the slopes of the dikes and in a less depth of water.

Core Samples—The object was to deposit fine material at the base of the dam over at least a third its width, reducing this width considerably, up to 30 ft. above the base and less rapidly for the remainder of the height. The line separating coarse from fine material was assumed to pass through the point where the steep sides of the pool changed to flatter slopes; this assumption was verified by sampling. Samples were dredged from the bottom of the pool each month in cross-sections 300 ft. apart. Results for the deepest section of the dam are shown in Fig. 4. After a time, an examination was made of 85,000 cu.yd. to estimate the proportion of fine material being sluiced from the dikes to the center of the dam; this was found to be 20% of the total.

A tank experiment was also made to determine the amount of fine it was possible to sluice from a sample.

Material from the borrow pits was sluiced as it was

shoveled onto a dike at one end of the tank, using a small hose connected to the regular sluicing lines. The total amount in place after sluicing amounted to 36.5 cu.ft.; the proportion of very fine removed was 20%.

A few dried samples from the dam core were tested on standard screens. They commonly ran 94% passing a 200-mesh, and 5.5% passing a 100-mesh and remaining on the 200. The loss by burning was about 2%. The increased amount of vegetable matter in the core over that found in the borrow-pit samples was due to the presence of top soil. (It has been determined by experiment that the presence of vegetable matter in soils diminishes the porosity in proportion to the amount of vegetable matter present (see ENG. NEWS, Mar. 7, 1907).

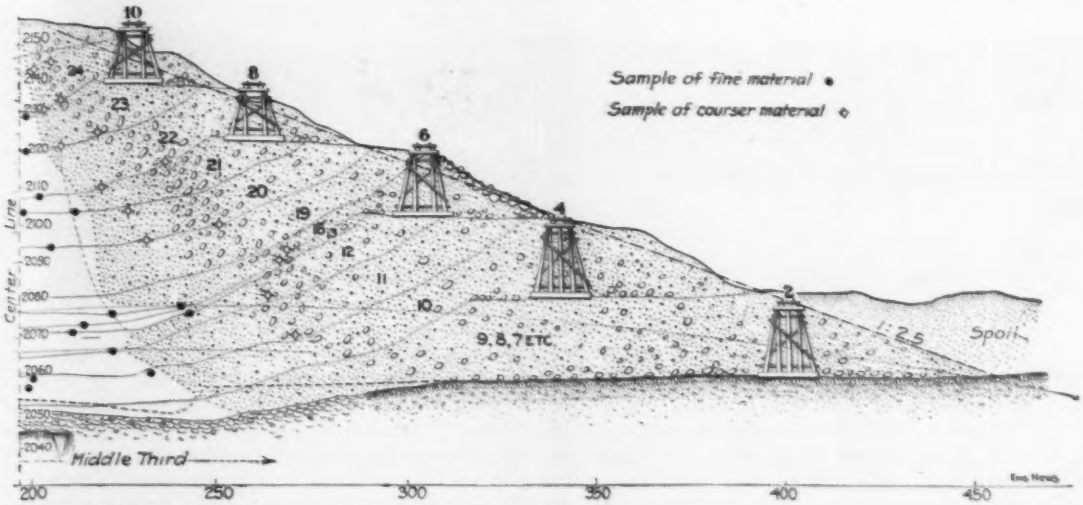
Careful elevations taken on the bottom of the pool after work had been discontinued for the winter of 1912-13 and repeated before the next season's work began showed no change either of settlement or rising, though the dikes themselves settled.

The method of determining which samples, taken from the pool bottom, should be classed as "fine" was by thrusting a pencil into the material in the sample bottle, the presence of coarse sand or gravel and very fine sand is easily detected in this way; if the pencil passed through the sample several times without encountering "grit" the sample was classed as "fine."

From the examination of all the samples and the change of slope of the sides of the pool, the location of the dotted line on Fig. 4 was determined as being the approximate line separating the fine core from the coarser materials. The coarsest material and rock, shown by Fig. 4, were always in sight; this was made a matter of photographic record. The extreme outer samples were always taken at the edge of the pool, therefore the area on the section, Fig. 4, covered by the samples is the area occupied by the pool during construction and shows the section of the dam deposited under water.

ADVANCED CONSTRUCTION—Dumping and sluicing from a trestle were carried on until a shelf of coarse material and boulders, too hard to sluice, had formed about four feet below the track level. The shelf was then dumped full and graded by the spreader cars, the track thrown to the edge of the fill and the operation of sluicing till a new shelf was formed, repeated. Track was advanced an average of 3 ft. per move, the time between moves being about three days and an elevation of 3 in. being gained at each move; thus providing for drainage of track and at the same time increasing height of dike. On completion of a dike to sufficient width, the next trestle was erected on the edge therof and dumping resumed.

Trestles 1 and 6 were about 20 ft. high; 7 to 10 were about 15 ft. high. The top of No. 1 was located inside the slope of the dam; Nos. 2, 3 and 4 were located with the center of track lying in the slope of the dam. In order that the pool and core should not narrow up too rapidly, trestles 5 to 10 were placed with their tops outside the slope. In the six upper dikes, sluicing began when a trestle had been filled to about half its height, this consolidated the fill about the trestle and provided the maximum amount of fine material for the core.



YARD EARTH-FILL DAM AT SOMERSET, VT.

FIGS. 5, 6 AND 7. BOILER HOUSE, PUMP HOUSE, AND SLUICING NOZZLE ON STAND

Dumping from trestles was much more rapid than from dikes and for this reason tracks were retained on the trestles as long as material could be sluiced away or until a very considerable bench of heavy material had formed. The time required for a nine-car train to be dumped from a trestle and get under way again was 1½ minutes; dumping from a dike when moving the train to clear the cars was necessary, the time required was from 2 to 3 minutes. With ten nine-car trains in operation, three trains each for two shovels and four for the third, and with an average haul of about 3000 ft. the tendency was to be short of trains—even when dumping from dikes and still more so when dumping from trestles. The shovel output averaged 100 cu.yd. per hr.

Caps and stringers were removed from each trestle and used in construction of the next set; posts, sills and bracing were left in place. Approach trestles, cribs and track fills crossing the dam-site were entirely removed.

During the first season, work was carried on both day and night, two and three sluicing gangs worked day and night but were actually engaged in sluicing only about half the time. In the second season, the east borrow pit was opened. Very little night work done. Three and four sluicing gangs were employed—often for 13 hours per day and a much greater proportion of the material was moved by sluicing than during the first season. To this was partly due the more rapid progress of the second season, another cause being the increased dumping area provided by the longer trestles and dikes.*

With three pumps working and four nozzles in operation intermittently, the discharge was about 750 cu.ft. per hr. per nozzle. To move 1 cu.ft. of material 2.8 cu.ft. of water was required; it should be noted that the material was thoroughly wet and washed down—not undercut and slid into the pool in dry masses. The nozzles worked against the end of the dump, advancing not over 50 ft. at a move, this being about the limit of effective work.

A few slides were caused by dumping dry on top of wet material taken from the borrow pits after a rain—also at points where the dikes had not been sluiced sufficiently flat before building the next trestle. The slides were controlled by thorough sluicing, light dumping and periods of rest, the object being to flatten the slope and allow the material to dry out.

*The writer is of the opinion that sluicing equipment, when used, should be brought to its full capacity at the beginning and use made of it for stripping the site; the efficiency of stripping in this manner was demonstrated by some work done here.

Use of Partly Built Dam—It was desired to store water in the spring of 1913 to be delivered during the low-water period of that year to the power stations at Shelburne Falls, three stations having been completed and put in operation late in 1912. Elevation 2110 was fixed as the height of this preliminary storage level.

Trestles 5 and 6 were built late in the fall of 1912, to allow storage to Elev. 2110, dike 5 had to be carried across and as much of dike 6 completed as conditions would permit. Dike 5 was finished first to the top of trestle 5 and a part of dike 6 dumped without sluicing; the result of this unbalanced sluicing is shown in Fig. 2 by the projection of a layer of coarse material into the core and one of fine material into the downstream dike.

The reservoir began filling about Mar. 12, 1913; on May 2 it had reached Elev. 2106. At this time, the cross-section of the dam was represented by the lines between estimates 14 and 19 on the north dike and 18 and 19 on the south dike; the surface of the pool was 15 ft. below that of the reservoir. On May 30, the pond level had reached Elev. 2111, and the pool a point 13 ft. lower; the fill had reached the line between estimates 19 and 20. At no time during the filling of the reservoir could leaks through the upper dike be detected.

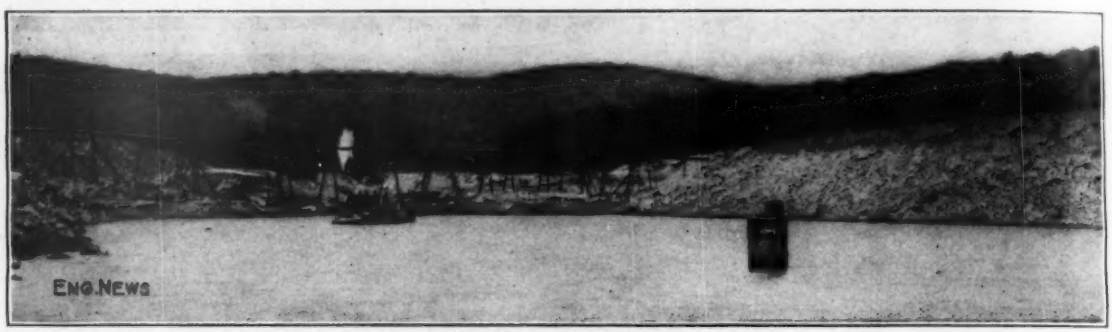


Fig. 8. Pool and Overflow

On May 30, the water stood in the same relation to the top of the dike as full reservoir would stand in relation to the top of dam (10 ft. below) but with the difference that, while the thickness of finished dam at full reservoir level was to be over 75 ft., the thickness of dike 5 at Elev. 2111 was 50 ft. Where dike 5 joined the slope of the easterly hillside, there was seepage amounting to 36 gal. per min.

All marketable timber had been removed from the flowage area, but much old and decayed growth and small timber and brush is still standing. The mulch throughout this entire area is very deep. The water in this reservoir after four months storage had the expected dark color of the water and a strong odor when agitated. This odor, naturally, was more noticeable at night, on account of the atmospheric conditions, but it entirely disappeared from the water after it had been aërated by a short flow down the rough stream bed. This condition of the stored water will, of course, disappear after a few years.

Core Pool—As the pool rose on the sluicing faces, small leaks occurred through the coarse material of both dikes, but they were quickly stopped by sluicing. After the elimination of the pool, there were no leaks through the dam, it being everywhere tight.

The surface of the pool was regulated by an overflow into the conduit, located near the center line of the dam and shown in Fig. 8. It was made up of sections of 18-in. concrete pipe, 6 in. thick and 15 in. long, with a tongue and groove on the inner circumference; sections were added as it was desired to increase the height of the pool; the joints were carefully calked and pointed.

A 12-in. trapezoidal weir was maintained on the overflow for measuring the amount of sluicing water used. It did not, however, serve its intended purpose as the constant rising of the pool bottom caused more water to flow over the weir than was actually being used at the time for sluicing. A screen around the overflow kept floating roots and bits of wood from clogging the pipe; two men were employed continuously to remove this floating material from the pool and also stumps and roots from the dikes.

During the season of 1912, discharge from the pool was almost constant, carrying with it a quantity of fine material (at times to nearly 100 cu.yd. per 24 hr.). Sulphate of aluminum was used to precipitate this material in 1912, partly by suspending in bags in the pool but mainly by the introduction of a solution into the force main at the pump house. With 1 lb. of alum to about 2600 cu.ft. of water, the precipitation amounted to about one-half the material in suspension; this made no difference in the color of the water discharged and it does not follow that a proportionate increase would remove the other 50%, part of it being of a very different character. (The amount of solids was determined by weighing and evaporating samples of the sluicing water.)

During the season of 1913, the dam increased in height much more rapidly than in 1912, the pool overflowing less than half the time and the alum was not used.

The method of eliminating the pool was by joining the dikes at the ends and gardually reducing its length till the overflow was reached and the last of the water forced out.

The top of the overflow pipe was at about Elev. 2148.5, a total height of 83 ft., a concrete plug was placed in the lower 30 ft. and the remainder filled with clay.

The downstream face of the dam has been left in terraces as deposited without much sluicing, the reservoir side has been sluiced. The distance betwen the top dikes was increased at the ends in order that the fine core material might deposit on the hillside to a greater width.

ORGANIZATION, ETC.—Design and construction of this dam was entrusted to the Power Construction Co., which handled all the related power-development projects on the Deerfield River for the New England Power Co., of which Chace & Harriman, Inc., are managers and Baker, Ayling & Co., are fiscal agents. Geo. W. Bunnell is President and A. A. Conger Hydraulic Engineer of the Construction Co. The Consulting Engineers were F. P. Stearns and Chas. T. Main, of Boston, and A. S. Crane (with J. G. White Engineering Corporation), of New York. Alfred Noble was Consulting Engineer for the state of Vermont in its scrutiny of the work. E. McD. Moore was Resident Engineer during the preliminary work and was followed by the writer (from June, 1912, to September, 1913); the dam was completed with C. F. Cook as Resident Engineer. (Sept.-Dec., 1913).

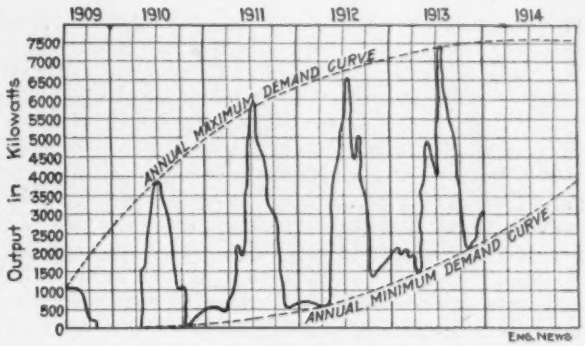
The construction work was inaugurated and carried along until January, 1913, by J. N. H. Cornell as General Manager of the Power Construction Co.; later the work was under the immediate direction of Mr. Bunnell.

Irrigation Service as an Electric-Power Load; Experience of the Minidoka Project

The growth of load on the hydro-electric station of the U. S. Reclamation Service at Minidoka Dam, Snake River, Idaho (described in ENGINEERING NEWS, July 6, 1911), is described by Barry Dibble, an engineer of Reclamation Service, in the official "Reclamation Record" for April, 1914. The following is taken from that account.

With 46-ft. fall, 10,000 hp. is developed, using water which must flow down the river for prior rights. Over 90% of this power is required for pumping during the height of the irrigation season, but during the winter the plant would be idle except for extensive use of power, in the towns and on the farms of the project, for heating and cooking as well as for light and power. [See notes on electrically heated high-school in Rupert, "Engineering News," Apr. 2, 1914, p. 725. —Ed.]

The probable demand would not have used more than a small portion of the power available for many years. The problem was to market the surplus during the winter. Electric cooking and heating were encouraged by giving low rates, and the demand has grown rapidly. On Jan. 1, 1913, the three towns of the project were served a maximum of nearly 1500 kw., an increase of nearly 100 per cent. over the amount used at the beginning of the preceding year. On Jan. 1, 1914, this had practically doubled again, being close to 3000 kw.



POWER OUTPUT OF THE MINIDOKA PROJECT HYDRO-ELECTRIC STATION

At first suitable electric heaters could not be obtained, and the Government engineers were called upon to design and build them. Now heaters are shipped to the project in large quantities by several electrical firms. For the ordinary household use of electricity for lights, ironing, washing machines, vacuum cleaners, and cook stoves, the energy costs from $3 to $4 per month, while to heat the same house it costs from four to eight or nine dollars a month in the winter.

The revenues from the sale of electric energy have increased very rapidly, amounting in 1910 to something over $500; in 1911 to over $5000, and in 1913 to over $15,500.

The increase in the winter demand is well illustrated by the accompanying diagram, which shows the variation in the power furnished by the plant since it began operations. The peaks recur each irrigation season when almost the full capacity of the plant is utilized in pumping for irrigation. The low points on the curve represent the winter power demand and show its rapid increase.

The upper dotted line shows the tendency of the maximum summer demand to become constant, approaching the capacity of the plant. The lower dotted line indicates a tendency of the minimum winter demand to increase more and more rapidly from year to year. If these two dotted curves are extended according to these tendencies, they will meet at some point off the diagram, representing a time before the year 1920. However, it is not expected that by 1920 the load on the plant will become constant.

Railway Destruction and Repair in Mexico*

At the outbreak of hostilities in Mexico, three years ago, it was imperative from the rebel standpoint, that the lines should be destroyed in order to hamper the movements of the Federal troops. Being well mounted, the rebels could dispense with the railways. The roads suffered severely, at first in the matter of bridges and trains; later (as the struggle grew more bitter) water-tanks, coal-sheds and stations were destroyed.

A large portion of the bridges in the northern part of the country were wooden trestles, and a small band of mounted men would ride along for miles, setting fire to one trestle after another. The timber was dry and burned rapidly. Later, dynamite was used for destroying the steel and masonry structures.

In the beginning, the railways made every effort to repair the damage and keep the lines open, but later it became necessary to abandon operation over portions of the system. The brunt of the repair work fell upon the Mexican trackmen and their loyalty was surprising, considering the scanty wages they received and the fact that their political inclinations were usually toward the rebels. The telegraph linemen had perhaps the most unpleasant task, since they traveled alone, as a rule, and frequently were held up, robbed and threatened.

For some time the city of Chihuahua was the center of operations, as the rebels were anxious to take the city and establish there the headquarters of their government. Accordingly, the railway bridges and the telegraph lines in all directions were destroyed. An outfit of about 140 men, of which the writer had charge, began work toward Chihuahua from the south. We had an escort of about 200 soldiers and had an armored car in which gatling guns were mounted. The car was an ordinary wooden box-car, lined with sheet steel, between which lining and the sides of the car was a layer of sand about 4 in. thick. The gatling guns were to be fired through the side doors, and portholes in the ends, and there were loop holes for rifles. Whether the car would prove valuable in action seems questionable.

In most cases our task of repairing the line was a simple one, from the constructional standpoint, our troubles being minor ones that were annoying chiefly because of the delay they caused when haste was so important. There was practically no difficulty from water, since most of the burned structures had spanned what were dry runs most of the year. In most cases the destruction was complete, nothing remaining but the iron bolts, drift pins, etc., scattered about in the ashes. The rails sagging across the openings were so stretched and twisted that they were of no further use.

We made no attempt to rebuild the structures in the usual way; but contented ourselves with cribbing the openings. This required a great quantity of material but was more rapid than rebuilding. We were hampered at the outset by the creosoted ties and by the lack of bridge stringers. The ties were so slippery that it was difficult to pile them into solid cribs. By sprinkling earth over them this trouble was overcome to some extent. The lack of stringers made it necessary to fill the openings with a solid mass of ties. This took material and what was worse it required extra time. Fortunately, we soon began to receive a plentiful supply of untreated ties and stringers. A supply train came to us from the south every day. We never did receive any iron work.

After reaching a burned bridge, the first task was to clear away the ashes and make sure that there were no hot embers remaining that might set fire to the cribs. For the first few days, we were so close behind the destroying parties that we came upon the bridges still smoking. When the ground was cleared and leveled, cribs of ties were built up to the necessary height. On top of these were laid stringers, and on the stringers were placed ties and new rails. We found it convenient not to remove the old rails until the cribs were up, so that men could work on top of them in handling the rail. It was convenient also to slide the heavy stringers along the old rails.

Laying the new rail usually consumed a considerable portion of the entire time at any one place. The expansion and creeping of the rails that remained in the track made it impossible to fill the gap with full-sized rails and at the same time secure a butt joint. We avoided the necessity of using butt joints by putting in switch points where we could; when that was not possible, we were forced to cut the rail to the proper lengths. As we had no rail saw and no means of repairing track chisels properly, rail cutting was a serious matter and caused much delay. There was also difficulty where our extra rails were not of the same size as the rails in the track.

Our most interesting task was at the Conchos River at Ortiz. There had been a pile trestle about 20 ft. high and 2100 ft. long, with a high earth fill at each end. Nothing remained but a row of blackened piles standing in smoldering ashes, with two lines of warped and twisted rails. To redrive the trestle would be a long job; besides we had neither piles nor piledriver. To crib the opening was out of the question. Fortunately, the bed of the stream was a desert, and we simply laid track across this. A roadbed was excavated down the side of each fill on a 2.5% grade. No surveying instruments were available, so the heights were estimated and the distances were paced. Care was necessary in laying out the grades, since it would have been embarassing to get the heavy work train down into the river and not be able to get it out again.

As there was a possibility that the track would have to be operated for some time, three small bridges were built to take care of small amounts of water that might come down. The location of these was determined after a study of the stream bed to determine the habits of the river at low water.

On the fourth day after reaching the river, our track was complete to the far side, and we were ready to move ahead. With the engine in the center of the train, we dropped down the grade into the river. Then the rear of the train was uncoupled and the engine pushed the front part of the train up the grade on the other side, returning for the rear part.

During the last few days our operations were greatly facilitated by the fact that we were able to maintain telephone connection with the outfit from Chihuahua and

*Extracts from a paper by L. F. Van Hagan, in the April "Wisconsin Engineer," University of Wisconsin, Madison, Wis. The paper refers to conditions some three years ago, at the opening of the rebellion, but is of interest as illustrating the methods which might have to be employed by the United States should the responsibility come upon it for the reopening of the Mexican railways.

also with a station to the south. We had a portable telephone set and wherever a stop was made, the first act was to hook the pole over the wire and find out conditions on either side of us.

A Dry-Land Mattress on the Mississippi

By F. Y. Parker*

In 1899, the steamer "Belle of Memphis" sank in the Mississippi River, three miles below Chester, Ill. At that time the river was upwards of a mile wide, the wreck in midstream, and the channel abrading the Missouri shore. Conditions being favorable—a wide reach of river, a silt-laden stream, extensive oscillation, and an obstruction—a bar immediately began to form with the wreck as a nucleus. This bar has augmented year after year until now, at a 10-ft. stage St. Louis gage, "Belle of Memphis" towhead is one mile long by one-half mile wide with nearly one-fourth of the island at an elevation of 25 ft. on the gage.

During the intervening years the river has widened to 6000 ft.; the additional width being gained by the wearing away of the Missouri shore; however, the river width did not keep pace with bar growth and the channel became narrow and crooked with an increasing volume of water directed to a secondary channel, north of the towhead. Since this secondary channel was much straighter and gave promise of widening, Col. C. McD. Townsend, in charge of St. Louis District, decided to close the old channel by a permeable pile dike.

In the late fall of 1913, the old channel was closed to navigation. A brush mattress 130 ft. wide, normal to the stream, was woven and sunk over the hurdle site: through the mattress, 30 ft. from the upstream edge, piles were driven to a penetration of 20 ft. in the river bottom. This dike was completed for 850 ft., the continuous low stage of the river preventing farther extension; however, the mattress was continued, over the top of the dry bar, for 500 ft. and heavily weighted with stone. The hurdle clogged with drift during last winter, throwing a large volume of water around the end of the dike; this excessive flow created a large and strong eddy at this point which undermined the entire length of the bar mattress, causing the mattress to drop vertically 20 ft. throughout almost the entire length. Nevertheless, soundings showed the mattress to be intact and in place. This scour was anticipated, and the mattress weighted accordingly. The upstream and downstream edges were loaded with stone more than the center; this caused the mattress to sink first, and to a greater extent, along the downstream edge. The final sectional position, as shown by soundings, resembles a broad inverted U, slanting slightly downstream.

*U. S. Assistant Engineer, Custom House, St. Louis, Mo.

This spring the hurdle was extended as far as the depth of water, on the towhead, would permit while the mattress was continued across the bar for 450 ft. beyond the water edge (Fig. 1). In the foreground of the view, the mattress is 130 ft. wide, in the background 100 ft.; the mattress is to be weighted with stone similar to that at the water edge. The target shown in the view is on the upstream side of the mattress at a bar elevation of 6 ft. above the water, but the elevation decreases to 2 ft. above the water level at the end of the mattress.

It is proposed to extend the mattress entirely across the head of the towhead, 1200 ft. farther, as soon as there is sufficient water to float the plant and at the same time push forward the hurdle as rapidly as conditions will permit. The present mattress extension, on the bar, will allow both operations to be prosecuted simultaneously.

When completed, the hurdle will total 3200 lin.ft.; the work up to May 1, 1914, is shown in Fig. 2.

Fig. 1. Building a Mattress on "Belle of Memphis" Towhead, Mississippi River, May 1, 1914

Fig. 2. Hurdle No. 9 at Crain's Island, Mississippi River, May 1, 1914

Unwatering Equipment for Pressure Tunnels of the Catskill Aqueduct

By Horace Carpenter*

One of the problems which early confronted the engineers of the Board of Water Supply of the City of New York, upon undertaking the design of the Catskill Aqueduct now nearing completion, was that of providing some means of unwatering the various pressure tunnels, by means of which the water is conveyed under certain deep valleys along the course of the aqueduct, and those portions of the downtake and uptake shafts which lie below an elevation to which unwatering by gravity is possible.

Between the Ashokan and the Hill View Reservoirs, there are five of these pressure tunnels, varying in length from 4000 ft. to five miles and lying at a depth below the lowest point in the profile of the valleys which they cross of from 400 to 1100 ft. and having an internal diameter of 14 to 14½ ft. Further, within the city limits, the tunnel has a length of some 18 miles, lies at a depth of from 200 to 700 ft. below the surface and has an internal diameter of from 11 to 15 ft.

It will thus be seen that very considerable quantities of water must be removed from any one of these tunnels before access can be had to it. Yet it was realized that it might be desirable to unwater one or more of these tunnels for inspection, or possibly for repairs, and that not only must the water contents be removed but provision must be made to pump the inward seepage of ground waters while the inspection or repair was in progress.

Provision for such equipment could not be safely left until the necessity for its use arose and it was decided that it should be provided as a part of the operating equipment of the aqueduct.

Careful study of what would be a reasonable rate for unwatering and the probable maximum rate of seepage into the tunnel led to the conclusion that a pumping capacity of about 1400 gal. per min. would be adequate. As it was inconceivable that more than one tunnel would require unwatering at any one time, a single equipment was proposed—adapted to all conditions of head to be pumped against. This equipment was to be kept in readiness at some central point and transported to the required point when necessary. The problem then was to secure, at minimum permanent investment, pumping equipment lending itself readily to dismantlement and transportation, so simple that it could be operated without undue delay by an inexperienced force and capable of operating at the desired capacity or over against heads varying from a few feet to 1100.

A number of alternative methods were discussed and four of these were taken up for preliminary design and cost comparison. These were:

(1) Use of a pair of large bailing buckets, balanced on either side of an operating pulley, one bucket descending to receive its load as the other rises to discharge; (2) use of an air lift, various types of which have been successfully used for similar purposes although none have had as great combined capacity and lift as here required; (3) use of specially designed direct-acting deep-well pumps, one of which, constructed of non-corrodible material, was to be installed permanently at the bottom of each drainage shaft, the operating mechanism only being transferred from one tunnel to another; (4) use of electrically operated centrifugal pumps mounted in a suitable floating chamber which should be allowed to sink with the receding water level in the vertical shafts.

The last method was determined to be the most feasible. In order to accelerate the unwatering when the head to be pumped against is low, to provide a spare unit during the longer operation of unwatering the tunnel proper, and to care for the unwatering of the Hudson tunnel, where a head of 1200 ft. or more, including pipe friction, is to be pumped against, it was decided to provide two units, each having a capacity of 1400 gal. per min. against 600-ft. head, the suction and discharge connections of these pumps to be so arranged that each pump could be operated independently or the two in parallel or the two in series. The pumps, motors and certain auxiliary apparatus were to be mounted in a steel chamber, or float, which should descend as the water level fell, the pump discharge pipe rising from the center of the float as a column, successive lengths being added to the same at the surface as required. The design as developed on this basis, is illustrated in Fig. 1. Provision was made at the tunnel under Croton Lake, to use the downtake waterway shaft for drainage. At the Hudson River tunnel, the uptake shaft was used. At the other tunnels special drainage shafts of the same diameter as the tunnel were sunk alongside the line of the tunnel at the lowest point in the traversed valley with the necessary connections from this shaft to the tunnel at the bottom.

The Float

The float consists of a platform and framework of structural shapes and plates, designed to take the entire load of the pumps, motors, discharge pipe and water column. This framework is surrounded by a water-tight steel casing of ¼-in. plate of such height as to furnish ample freeboard above the maximum submergence of the float. It is provided with a hood or cap for the protection of the occupants from falling articles and from water dripping from the joints of the discharge pipe or from the sides of the vertical shaft. Ventilation is provided by a series of louvers around the side of this cap and by a small motor-operated blower placed inside the float. Light is furnished by incandescent electric lamps. Access to the interior is obtained through a trap door in the top of the cap.

It will be noted from Fig. 1 that the float is built with a false bottom so that should any obstruction be met, on coming to rest at the bottom of the shaft, and the outer bottom be punctured, there will be no danger of flooding the interior of the float.

To prevent the float from rotating, there are two guideways, diametrically opposite, extending the entire height of the float and engaging with corresponding guides molded of concrete as an integral part of the shaft lining.

Owing to the bulk of this float, no effort is to be made to transport it from tunnel to tunnel but a float is installed permanently at each drainage shaft, resting in a chamber above water level and without machinery.

*Mechanical and Electrical Engineer, 44 South Central Ave., Wollaston, Mass., formerly Mechanical Engineer, N. Y. Board of Water Supply.

The Pumps

The pumps, which were designed in detail by the engineers of the Board, are of a 9-in. four-stage turbine type designed to operate at 1760 r.p.m. The four impellers are arranged in pairs with their suction openings in opposite directions so that the vertical thrust of the pump is reduced to a minimum. This minimum is taken care of by a balancing disk attached to the bottom of the pump shaft with connections to the pump discharge of such design that the pressure on either side of the disk can be regulated so that the whole set of impellers in operation floats on a water cushion.

By placing the suction connection of the pump at the top, instead of at the bottom, the stuffing-box, through which the pump shaft passes at the top, is under minimum pressure and requires little or no attention when the pump is in operation.

The impellers and diffusion rings are of bronze and so far as possible throughout the entire design, opposing metallic surfaces are bronze or bronze on iron to facilitate disassembling for inspection or transportation.

Suction and Discharge Piping

As already stated, the suction and discharge piping is arranged so that either pump may be operated alone, or the two in parallel (in which case the two discharges are brought into the common discharge rising from the center of the float), or one may discharge into the suction of the

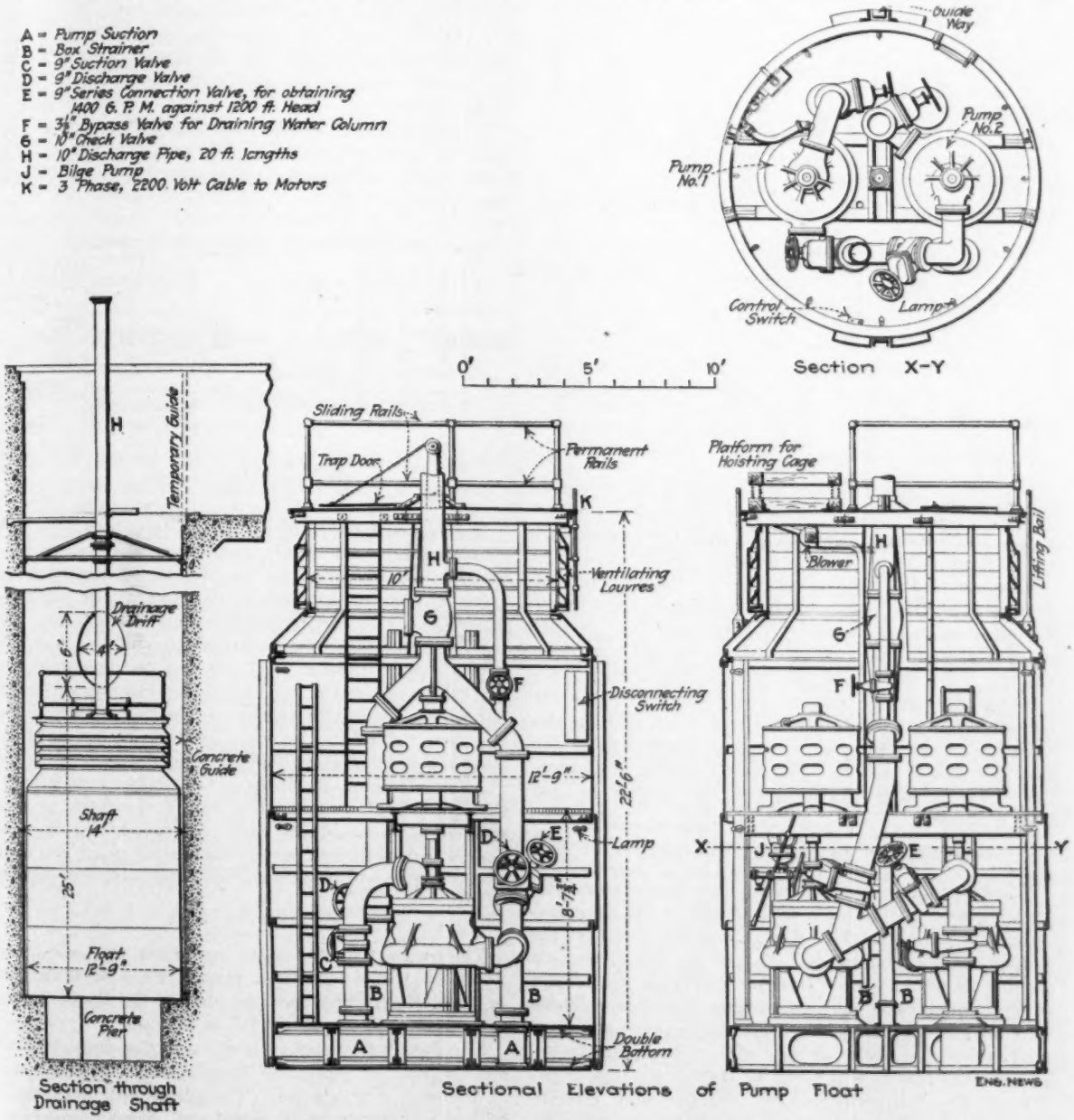


FIG. 1. ARRANGEMENT FOR UNWATERING THE NEW YORK AQUEDUCT PRESSURE TUNNELS

(Showing (1) a drainage shaft with pump float at bottom, (2) plan and sectional elevations of the float equipped.)

other to place the two pumps in series for operation against a head of 1200 ft. As shown in Fig. 1, these shifts are made by opening and closing proper gate valves.

All the piping inside the float is of cast iron, but after leaving the float, the discharge line, for heads up to six hundred feet, is carried by lap-welded steel tubing having a nominal inside diameter of 10 in. and a $\frac{3}{16}$-in. wall. This pipe is made up in 20-ft. lengths, the joint between successive lengths being of a standard flange type slightly modified to provide for easy making-up and dismantling. Rubber gaskets are used between the joint faces.

As it was impossible to provide for the suspension of this pipe at any point along its entire length, it has to stand as a column supported by the float and it was necessary to provide against excessive lateral deflection.

Guides extending across one diameter of the shaft and made sufficiently stiff to guard against deflection of the pipe in a direction vertical to their length, are rigidly bolted to the pipe column just above and below each joint. The outer ends of the guides are provided with roller-lined ways which engage the same concrete guides as do those on the float. The pipe guides thus sink with the float and hold the deflection of the pipe column within allowable limits.

At the surface, the discharge pipe terminates in a quarter bend, a single length of horizontal pipe and a flexible tube leading to the discharge sump from whence the water flows into adjacent streams. This portion of the pipe is suspended with counterweights, from a special jib-crane attached to the wall of the drainage chamber, so it can easily be handled when a new length of discharge pipe is to be added.

The Motors

Directly connected to the shaft of each pump by means of a flexible coupling, but supported independently of the pump, is a 450-hp., 2200-volt, 60-cycle, three-phase vertical induction motor of squirrel-cage type.

The use of the squirrel-cage motor for this class of work is unusual, it being common practice to use a motor having a coil-wound rotor with slip rings for external resistance connections, on account of the better starting characteristics of this arrangement. The greater simplicity of the squirrel-cage motor, the freedom from short circuits due to moisture between slip rings, and the desirability of carrying as few cables as possible down the shaft led this departure. The highly satisfactory operation of the motors in service proved the selection to have been well made.

Auxiliary Electrical Equipment

The two motors are controlled by a single automatic starter placed on the main switchboard in the drainage-equipment chamber. This starter is so designed that the motors may be started and stopped by the closing or opening of either one of two small switches placed one at the switchboard and one inside the float. These switches are interlocked so that the operator at either end can lock the starter in the "off" position, thus insuring that the motors will never be started through error.

From the main switchboard, the following circuits extend to the float: (1) the main motor circuit; (2) the automatic starter circuit; (3) an automatic-starter circuit for the cable reel (to be described later); (4) a lighting circuit for the interior of the float, and (5) a telephone circuit by means of which communication is had at all times between the surface and the interior of the float.

Since the distance between the switchboard and the float is constantly changing as the latter descends the shaft, it was necessary to arrange some method of paying out the cables between these two points from time to time as required. This is accomplished by leading the various circuits from the switchboard to two cables wound on a large reel (see Fig. 2) set up on the edge of the shaft. Here, the main motor circuit is connected, through slip rings, to a three-conductor cable, rubber covered, cotton braided and saturated with moisture-proof compound. The other end of this cable is led down the shaft to the float, where it is divided by two disconnecting switches into a circuit for each motor. By opening either of these switches, the corresponding motor can be isolated from service and the other motor operated alone if desired.

In like manner the auxiliary circuits are taken in a cable of similar construction to a small switch panel within the float and there separated for their various uses.

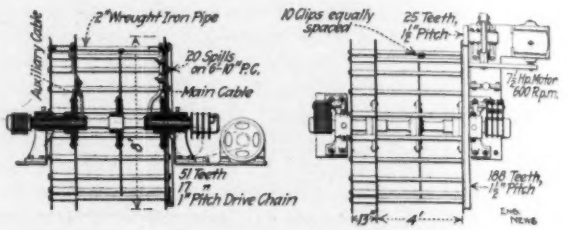


Fig. 2. Reel for Electric Cables; Aqueduct Tunnel Drainage Equipment

The reel is operated by a small motor which is in turn controlled by a self-starter mounted on the main switchboard. The control circuit for this starter is led through a specially designed switch in the float, to the operating handle of which is attached the main motor cable. As the latter tightens, due to the sinking of the float, the switch will be thrown "on," the reel motor started and the cables run out a predetermined distance, on reaching which, the switch returns to the "off" position, the reel motor stops and no more cable is let out until the main-motor cable again tightens.

As a safeguard, the main-motor control circuit is led through a little plug switch, within the float, in such manner that should the cable-reel switch fail to work and the cables tighten beyond the desired point, the main motor starter will be thrown "off" and pumping stopped.

Operating Test

The contract for the above equipment was awarded in April, 1911, and completed, ready for the operating test in June, 1912. This test took place at the Rondout pressure tunnel and was conducted as follows:

The float was placed in position in the drainage shaft and the interior equipment installed and the first length of discharge pipe attached. The pumps were then started with the discharge valves closed until the pumps had attained full speed after which the discharge valves were opened, one after the other, until full load was thrown

on the motors as indicated by the wattmeters within the float, one being provided for each motor.

Pumping was continued until the float had sunk so that the horizontal length of discharge pipe was within about three feet of the floor. Then the pumps were stopped, the discharge pipe disconnected at the quarter bend, a second length of pipe with its accompanying guide inserted, and pumping resumed.

This continued until the float reached the level of the top of the tunnel, after which the sinking of the float proceeded very slowly, pumping continuing for a number of days without the necessity of adding an additional length of pipe.

This test extending as it did over some 20 days, during 11 of which one of the pumps was in constant operation for 24 hours per day, demonstrated that aside from certain changes in minor details the equipment was of a very satisfactory nature for the work for which it was designed.

In the preliminary studies for this equipment, the writer was associated with other engineers of the Board and the detail designs and construction were under his direction as Mechanical Engineer at Headquarters Department, under the control of Alfred D. Flinn, Department Engineer and J. Waldo Smith, Chief Engineer.

Recording the Underground Structures in Los Angeles Streets

(CONTRIBUTED)

Los Angeles is now trying to remedy the mistake once made there, and still made in very many cities—that of failure to record the position of the many pipes, conduits and miscellaneous service structures buried beneath the pavements of public rights-of-way.

When the design of an extensive system of storm sewers was undertaken and a layout considered for conduits to carry electric wires underground, the records of location of existing pipes, sewers, conduits, etc., was far from satisfactory. Consequently, after a time it became necessary to appropriate several thousand dollars for surveys to supply the desired information as far as possible.

It has been shown beyond doubt, for this city at least, that the most practical form of these records is a series of sheet plans or maps of the streets, the scale being not smaller than 20 ft. to 1 in. and, in crowded portions, 10 ft. or less. Upon these plans are drawn the pipes and other structures to scale, each being tinted with a different color. In most cases, the dimensions are indicated for each structure and where it does not confuse the plan the distance from street or center line is shown. Each change of grade for new work, the elevation of the top of the pipe or structure are shown on the map and similarly where the elevation has been obtained from excavation.

The electric-supply and telephone conduits have been comparatively easy to locate by surface survey with measurements in the manholes and junction chambers which are necessarily located at every angle point in the line. Some of the local companies have coöperated in the work, but perhaps not to such an extent as their own best interest might warrant. The location of old pipes and sewers is less easy and in some cases, where there is an urgent need for information, extensive street excavations have been necessitated. In general, however, the work has been carried on by making location surveys wherever pipes have been exposed during excavation for new work. In every case of excavation in the streets it is necessary to obtain a permit before opening the pavements and the underground-survey department is thereby kept informed as to the progress of such work about the city and is able to send men to locate whatever may be exposed.

When there is a press of work, it is not always possible to send a level party to each opening, but one or two men can go with a tape and make measurements to obtain the location and cover of pipe. Location is carefully referred to some surface lines so that later a level party can obtain elevations at all points from which the depth measurements have been made. Sometimes the elevation of the pipe can be obtained directly with a tape by referring to the profile of the line being laid.

All information obtained in the field is entered on the plan at the proper location, in pencil if not complete. Later a sketch showing the location of all desired points is given to a level party to obtain surface elevation for all points in a series of blocks where the excavations were made. From these elevations the depths previously obtained are subtracted and the resulting elevation entered upon the plan at the proper point.

In paved streets, it seems to save money to proceed in this manner, even where the force is not crowded for time as the leveling can all be done without delay. It also seems to save much time if the places where original measurements were made are marked in some semipermanent manner. In all new work, it has been found advisable to take levels as work progresses, and this is absolutely necessary on unimproved streets where no surface is permanent enough to measure from.

It has been found very important that elevations (rather than depth of covers) of pipe be recorded for several reasons. (1) If depths merely are taken (as has been the almost universal custom here in the past) on streets that are not permanently improved, when the data is most needed they are almost meaningless—due to subsequent grade changes which can be traced, if at all, only by laborious searches and computations with uncertain results. (2) Where depths are given from improved surfaces, even then there have been important changes—due to rapid growth of values and consequent alterations to admit of still greater improvements. (3) Even though no change in the street surface occurs, in order to obtain at all accurate elevation of specific points on different pipes, it is necessary to study profiles and cross-sections of streets, and this carries with it almost endless labor and many chances of error due to mistakes in interpretation of plans or to variations between the constructed street surface and the recorded plans under which it may have been laid.

The Los Angeles underground surveys and records are made under the direction of J. W. Cooke.

The experience here shows that it is the duty of every city engineer in places of any considerable size, at least, to impress on the members of city councils, civic bodies, and the officers of local utility corporations, the rapidly increasing importance of such records as have been discussed.

Des Moines River Viaduct: C., M. and St. P. Railway

By J. H. Prior*

SYNOPSIS—Unusually heavy steel viaduct, double-track, with four lines of deck plate-girders carrying reinforced-concrete floor slabs for ballast floor. Towers 40 ft., intermediate spans 70 ft. Two deck truss spans cross the river, on a rocker bent at midstream. Pile foundations. Erection with derrick-car with 80-ft. boom. River spans erected on falsework. All erection done by railway company's force.

The Chicago, Milwaukee & St. Paul Ry. has recently completed a steel viaduct across the Des Moines River valley, three miles west of Madrid, Iowa, and 17 miles south of the Boone Viaduct of the Chicago & Northwestern Ry.† It forms part of the double-track reconstruction work in Iowa, and is on a direct cutoff from Madrid to Woodward. The present line between these points (crossing the river about two miles southeast) is single track and 7.65 miles in length. The new line reduces the distance 2.13 miles, and eliminates 790° of curvature and 197 ft. rise and fall. The east approach of the viaduct is a double-track fill, 3500 ft. long, with a maximum height of about 100 ft. and containing approximately 1,300,000 cu.yd.

The viaduct, shown in Fig. 1, is a double-track structure, having a total length of 2394 ft. and a maximum height of about 130 ft. The superstructure consists in general of 40-ft. tower spans and 70-ft. intermediate girder spans. The main channel of the river is crossed by two 155-ft. riveted deck-truss spans, supported by the adjacent tower bents and a single rocker bent in the middle of the channel. The location is on tangent and a grade of 0.66% rising to the west. The viaduct was designed for a live-load of Cooper's E-55 classification (two 195.25-ton engines followed by a train load of 5500 lb. per lin.ft. of track). The dead-load consisted of the estimated weight of the structure and the weight of reinforced-concrete deck slabs and a ballast floor, the latter being taken as 3900 lb. per lin.ft. of track.

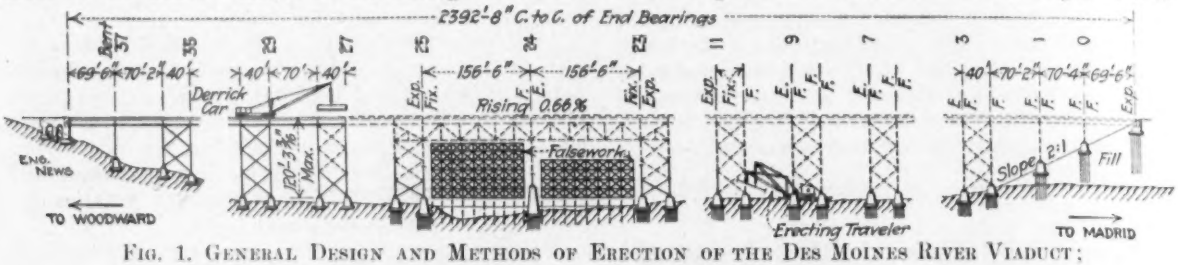


Fig. 1. General Design and Methods of Erection of the Des Moines River Viaduct; Chicago, Milwaukee & St. Paul Ry.

(The traveler on the ground erected the lower portions of the towers. The derrick car completed the towers, placed the girders and erected the truss spans.)

*Assistant Chief Engineer, Illinois Public Utilities Commission; formerly Engineer of Design, Chicago, Milwaukee & St. Paul Ry.

†"Engineering News," 1901, I. 415, 416; II, 117, 266.

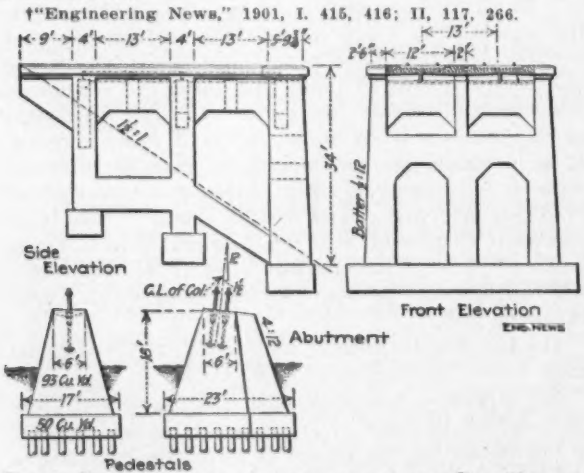


Fig. 2. Pedestals and Abutment for the Des Moines River Viaduct

Substructure

Borings showed that from the west abutment to bent No. 27, there was a thick bed of stiff yellow clay 6 ft. to 10 ft. below the surface of the ground. Tests proved this to be good for an average pressure of over 3 tons per sq. ft., and the footings were designed accordingly. East from bent No. 26, there is sand 25 to 35 ft. deep, beneath which is a stratum of hardpan. Piles were used to support these foundations. They were jetted on the average 26 ft. through the sand and driven 12 ft. to 14 ft. into the hardpan. The jetting was done with a 2-in. pipe, with a pressure of 140 to 160 lb. at the nozzle. The hardpan was penetrated with difficulty, the piles moving only about an inch under each blow of a 2800-lb. drop hammer falling about 30 ft. The last inch penetration required on the average three blows. The average pile load was assumed as 18 tons.

The pedestals (except in bents No. 0 and No. 1) are 6 ft. square on top and slope toward the center line of the viaduct, making the bearing surface normal to the axis of the columns, which are on a batter of 1½ in 12. Fig. 2 shows a typical pedestal, the nose being on the upstream side. In each pedestal are two 2-in. anchor bolts 10 ft. long. Each bedplate is fastened to the masonry with eight 2-in. fox bolts, 30 in. long, holes for which were drilled after erecting the bedplates and columns.

To provide for any lateral motion that may accompany the settling of the fill, the pedestals in bents No. 1 were built with horizontal tops 8x10 ft. and their bedplates were made with slotted holes, so that the bedplates can be

shifted and the superstructure adjusted in case the pedestals are pushed forward. Creosoted piles 40 to 45 ft. long sustain these pedestals and have an average load of but 12 tons.

The abutment design is shown in Fig. 2. At the east end, however, on account of the expense of an abutment built from the ground up and the uncertainty of its withstanding the pressure and settling of the fill, it was decided to use temporarily a small bank abutment. This rests on 60-ft. creosoted piles, carrying an average load of 12 tons. It consists of a thick reinforced-concrete slab with timber backwall, and reinforcing bars were provided for a permanent concrete backwall which will be constructed when the embankment becomes thoroughly settled.

The concrete was 1:3½:5 for the footings, and 1:3:4½ for the neatwork. An excellent grade of sand was found ¼ mile east of the viaduct, containing about 20% gravel. The stone was a good grade of screened limestone, 1 to 2 in. largest dimensions; no crusher run was used. Water was pumped from the river. The concrete for the abutments and the pedestals on the end slopes was mixed at the foot of the slopes and hoisted in concrete cars on an inclined track. The concrete in the pedestals on the level ground was placed by means of a stiffleg derrick.

The neatwork of all pedestals was poured in continuous runs, which necessitated working at night on a few of the largest pedestals. The largest run, 215 cu.yd. (for the pedestals of bent No. 24), was made in 24 hr., using one mixer. Most of the concrete work was carried on during the winter. The sand was heated by steam pipes to a temperature of about 100° F.; the water to about 150° F. The stone was not heated. After being poured, the pedestals were housed in and live steam turned in for a period of about four days. The results were excellent even during the coldest weather. The total volume of concrete in the pedestals and abutments amounted to 11,850 cu.yd.

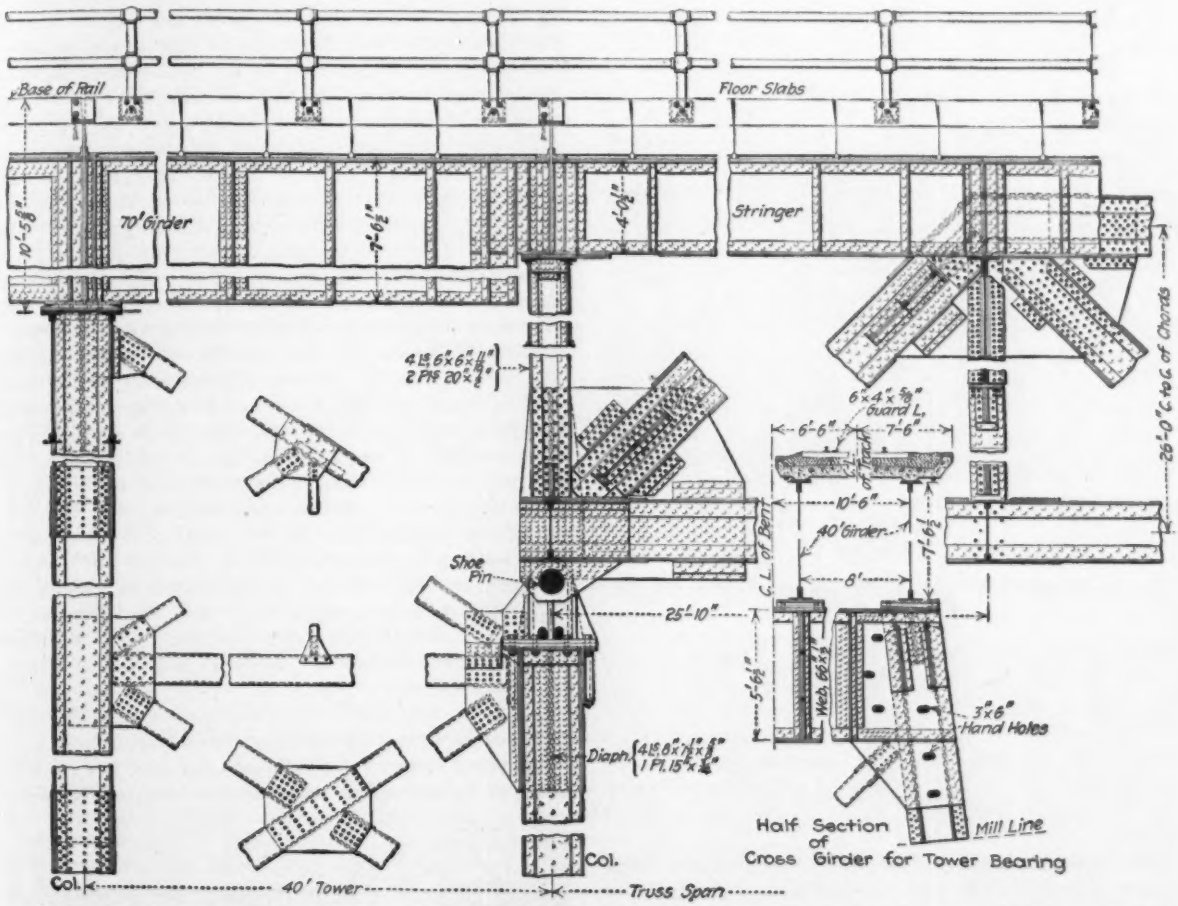


FIG. 3. SHORE TOWER AND END OF TRUSS SPAN, DES MOINES RIVER VIADUCT; CHICAGO, MILWAUKEE & ST. PAUL RY.

The west bank of the river for a distance of about 700 ft. above and 300 ft. below the bridge was thoroughly riprapped, as the soil is soft and the bank has been rapidly wearing away for some time. Further protection was obtained by wing dams built up to the ordinary high-water level. Riprap was also placed around each of the pedestals in bents Nos. 3 to 25, inclusive, as a protection against scour during the flood period, when the water frequently covers the entire flat.

SUPERSTRUCTURE

GIRDERS—The deck girders are spaced 8 ft. c. to c., and are carried directly on top of the cross-girders, as shown

in Fig. 3. They differ slightly from the railway's standard in that the web does not project above the top flange angles, cover-plates being used in order that the concrete deck slabs should have central bearing on the girders. The slabs are provided with bearing strips which rest on the cover-plates between the inner line of rivets. At the ends of the 70-ft. girders, where the cover-plate is not required, the bearing is formed by a plate of the same

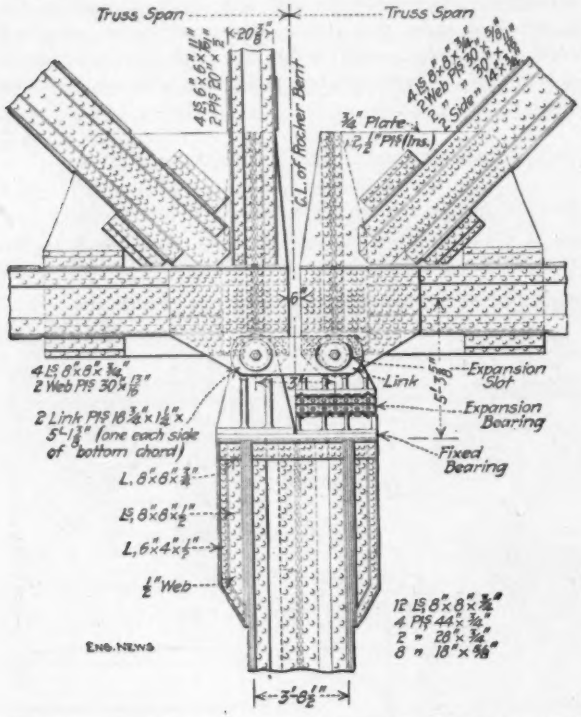


FIG. 4. SUPPORT OF ENDS OF TRUSS SPANS ON THE ROCKER BENT

thickness but of a width only sufficient to engage the rivets on the inner line in the flange angles. Holes for future staging are provided in the outstanding legs of the stiffener angles of all girders and cross-girders. Over every bent, one girder span has ladder bolts through the outstanding legs of the two outside end stiffener angles, the bolt heads being countersunk in the end stiffener angles.

The cross-girders are box-girders, diaphragms being placed directly under the two inside deck-girders, and also at the splices of the web plates and gusset plates. At the ends, the webs are shop-spliced to the gusset plates, which are shop riveted to the outstanding legs of the column angles, the columns being spliced below the gusset plates. These gusset plates are also slotted on one side of the cross-girder to permit the gussets for the longitudinal bracing to be entered and riveted to the column webs and angles. This construction is easily erected and presents an excellent appearance. Hand holes in the gusset plates and ladder bolts at the ends of the cross-girders provide for inspection and painting.

COLUMNS—The upper and middle sections of the columns in all bents (except Nos. 23 to 26, inclusive) are of built-up channel section composed of two webs 26x$\frac{1}{2}$ in. and four angles 6x6x$\frac{3}{4}$ in. The rivet holes in the webs were drilled from the solid, except such as were required in assembling. After the holes in the angles were subpunched, the angles were bolted to the webs through the above mentioned assembling holes, and were then reamed with a twist drill which passed entirely through the webs.

BRACING—The longitudinal and transverse bracing is a double system capable of taking both tension and compression, and is made up of channels turned in and laced. One diagonal of the longitudinal bracing is in all cases carried through the intersection as a single member, while the other one is broken. This is done to provide an additional safety factor against sagging. The tendency to sag is greatly increased by the fact that the longitudinal braces do not stand in a vertical plane, but are in the same plane as the columns of the towers. In the transverse system, all the diagonals were broken at intersection points, the tendency to sag not being so great, as the bracing lies in a vertical plane, and the method used made the erection somewhat simpler.

The double system of bracing was chosen because of the increased rigidity, as well as strength being an important consideration in high viaducts. At the top, the towers are braced in a horizontal plane by cross frames composed of two 6x4x$\frac{5}{8}$-in. angles riveted back to back. These laterals connect to large lateral plates riveted to the tops of the columns and cross-girders, and are also riveted to the lower flange of the inside tower girders.

SHORE TOWERS—The bents of the two shore towers are 4 in. wider than the others. The columns of the river bents (Nos. 23 and 25) are cut off at the proper elevation to support the shoes of the truss span which are placed directly on top of the columns, a 2-in. plate under the bearings securing an equal distribution of the load over the column section. Struts are substituted for the cross-girders in these bents, and the longitudinal and transverse bracing is somewhat heavier. At the top, there is but one diagonal, which is braced against sagging by an inclined transverse crossframe between the diagonals of the tower, and extends from the middle to the point where the lower end of the diagonal joins the column of the river bent.

The horizontal thrust from the truss span is designed to be partly carried through the tower bracing by a horizontal strut, connecting the top of river bent to a point in the same horizontal plane on the rear bent of the tower.

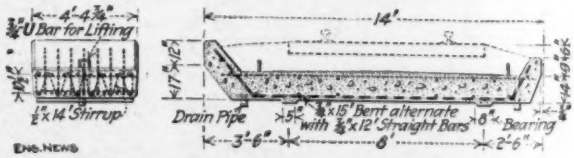


FIG. 5. REINFORCED-CONCRETE SLAB FOR BALLASTED DECK OF VIADUCT

Thus the thrust from the truss span is equally distributed into all of the tower pedestals. The shoes on top of the river bents are each connected to the columns with eight bolts. Four bolts pass through the heavy 2-in. plate and connect to the horizontal cap angles on the longitudinal sides of the columns. The other two, which anchor the bearing, pass through the same plates and engage lug angles riveted vertically on the transverse sides of the columns.

ROCKER BENT—On account of the heavy loads, it was necessary to use heavier columns for the rocker bent be-

tween the truss spans. An H-section was adopted because of the simpler shop work for the large amount of metal required for the section, and because of the advantage in having continuous webs in both directions. At the base the columns rest on cast-steel rocker shoes connected by a 14-in. pin. The load is further distributed by means of I-beam grillages which were filled with concrete before the superstructure upon them was fully erected.

The main section of these columns is shown in Fig. 4, which also shows the manner in which they are widened at the top to provide seats for the bedplates of the truss spans. The columns are reinforced with horizontal diaphragms placed about 11 ft. apart. The flanges are braced by the transverse gusset plates, batten plates and single-angle lacing. The gusset and batten plates are provided with 3x6-in. hand holes. The transverse bracing in the rocker bent is composed of four 8x6-in. angles laced horizontally with 3½x3½-in. angles and vertically with 3x$\frac{7}{16}$-in. bars.

The west truss has a fixed bearing on the rocker bent while the east truss has segmental rollers for expansion. By this arrangement, the traction forces in the truss spans are equally divided between the two river towers, whereas had the expansion been placed at either of the river towers, the bracing in the opposite river tower must necessarily have been very heavy. Large links having one round hole for the fixed end and one slotted hole for the expansion end engage the pins on each side of the shoes and limit the movement due to expansion and contraction. These are provided as an extra precaution in case of the settlement of either shore tower, so that the spans would still be held at the rocker bent.

Truss Spans.—Each double-track channel span has two riveted deck trusses of the Warren type. The tops of the floor-beams are flush with the bottom of the top chord, the stringers being placed on top of the floor-beams, and being spaced the same as the girders on the trestle. This arrangement allows the floor to be uniform from end to end of the viaduct. It also prevents the projecting ends of the floor-beams from marring the appearance of the structure.

In the end panel, shown in Fig. 3, the stringers are riveted to the floor-beam joining the vertical posts which come directly over the end bearing points. The 40-ft. girder spans, which also rest on this floor-beam, have expansion provided at their bearings on the floor-beam. This detail enables the vertical post to move when the truss span deflects, without causing excessive bending stresses. Thrust frames in these panels in a plane below the stringers transfer all thrust to the truss at the intersection of the top chord and end post.

Concrete Slab Floor

The entire viaduct has a deck of reinforced-concrete slabs, with ballasted track, as in Figs. 2 and 5. The outer edges of the slabs are brought up to the elevation of the base of rail to give a more substantial appearance. Refuge platforms, formed by two special slabs having the outside parapet extended, are provided about 150 ft. apart, in staggered position. The concrete bearing strip on the slabs (previously noted) brings the center of bearing over the center of the girder, instead of being out beyond the vertical leg of flange angle, as is the case where the web projects above the top flange angles and the slabs are notched. It also permits the top lateral plates to be riveted to the top flanges of the girders by means of full head rivets, and permits the lateral plates to be painted.

The cover-plate takes up any tension brought into the flange of the girder from the lateral system. Where the cover-plate is not used, the laterals cause tension on the rivet heads in the vertical leg of the flange angles. The tendency of the slabs to lateral motion (which is very small) is taken care of by the rivet heads in the inner gage of the top flange. Lift stirrups facilitate handling of the slabs. A 2-in. fiber pipe was placed toward each side and the middle of each slab for drainage purposes. The slabs were all cast during cold weather, the forms being housed in and heated by means of steam pipes underneath the floor. The roofs of the slab houses were

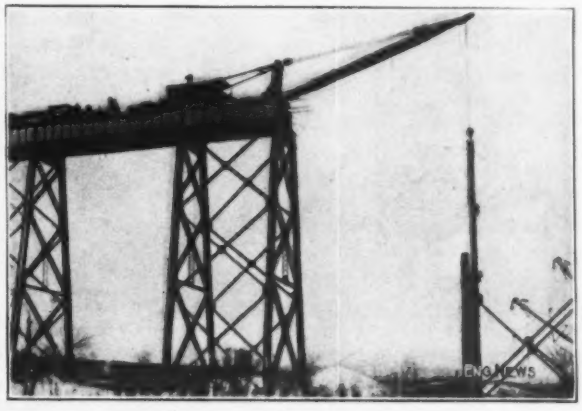


Fig. 6. Derrick Car Erecting the Steelwork of the Des Moines River Viaduct

trap doors through which the slabs were lifted after they had set.

At all expansion joints, the slabs are fitted to lug angles, riveted with the outstanding leg flush with the end of the girder or stringers. The spaces between the slabs at these joints are spanned with ½x10-in. bent steel cover-plates anchored to the slab on one side by fox bolts ½x8 in. Open holes are provided in the outside parapet wall of alternate slabs, and through these are bolted the castings for the stanchions of the 2-in. pipe railing. The track guard rails are angles 6x4 in., but are provided only next to inside rails, as shown in Fig. 3.

Erection

The erection was begun and carried forward from the west end, as the long, high fill at the east end was not finished until after the completion of the viaduct. A temporary track connected the main line with the west end of the bridge and provided a storage yard for materials.

All material, except the lower panels and the castings of the towers, was erected from the track level with a 50-ton derrick car, equipped with an 80-ft. boom and 50-hp. engine. The procedure found most satisfactory was to erect each bent complete, place the girders and laterals, and lastly place the longitudinal tower bracing. The method is illustrated by Fig. 1, in which bent No. 27 is shown completely erected, and the derrick car is placing the 40-ft. tower spans. The longitudinal brac-

ing shown dotted in the upper stories of the towers is yet to be placed. Temporary ties and rails were laid as the work advanced. Fig. 6 shows the derrick car at work.

The material to be erected was brought out on flat cars as far as possible on the track opposite the derrick car, and was then carried to position, suspended from the boom. The bracing and laterals were handled with runner lines; the girders were handled with the load line and were grasped with hooks consisting of two hooked bars attached to a ring. The maximum stresses produced in the derrick were caused when placing the 18-ton cross-girders with the boom reaching across a 70-ft. span, and swinging in a distance of 6 ft. 8 in. from the center line of derrick-car track. The shipping weights of some heavy members are as follows: cross-girder for single bents, 36,300 lb.; 70-ft. girder, 36,500 lb.; middle

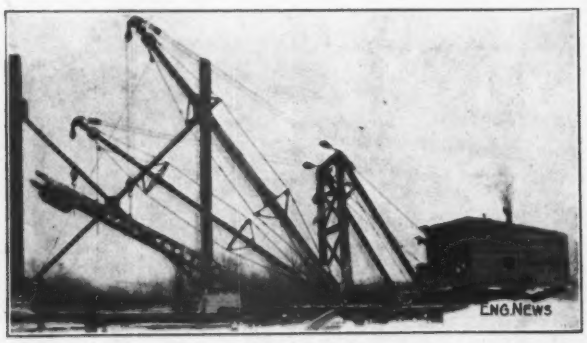


FIG. 7. TRAVELER FOR ERECTING THE LOWER PORTION OF THE VIADUCT TOWERS

section of column of rocker bent, 72,700 lb.; long bottom-chord member, 58,000 lb.

All riveting was done with pneumatic hammers with a pressure of about 105 lb. The compressor was located on the west side and was driven by a 40-hp. gasoline engine. About 23 field rivets per ton of metal were required for the trestle spans, and 30 for the truss spans. The riveting was carried on continually from the time the erection started, the greatest number driven in one day being about 1900, with four gangs working.

From bent No. 32 to bent 4, on comparatively level ground, the lower stories of the towers were erected by means of a mule traveler, Figs. 1 and 7, equipped with two 60-ft. booms and two double-cylinder engines with double-friction drums and four independent winch heads. This traveler ran on a track of 18-ft. gage along the center line of the viaduct. The material erected by the traveler was delivered on the flat east of the river and was brought out for erection on a low-level temporary construction track, 60 ft. south of the center line.

It was originally the intention to have this traveler assist in the erection of the upper stories of the towers by keeping the derrick car supplied with material, but the shipments of the steel for the truss spans were delayed, so the work on the lower stories was continued and entirely completed before the erection of the truss spans was begun. The traveler was then moved out a sufficient distance to clear the pedestals, and run back to the truss spans to assist in the erection of the falsework.

The truss spans were erected on falsework supported by piles, Fig. 1. The framed timber falsework bents, three stories high, were constructed of 12x12-in. posts, caps and sills. Longitudinal struts and all bracing were 3x12 in. Caps and sills were driftbolted and the bracing spiked. Each story was framed in units, those for the two lower stories being framed on the pile caps and lifted into place by the traveler. Those for the top story were framed at the west end of the bridge and (with the stringers and blocking) were placed in position by the derrick car as the work advanced. After the west truss had been swung, the stringers and units in the upper story of the falsework were taken down and used under the east truss.

The most difficult problem in connection with the erection was the handling of the 72,700-lb. middle sections of the rocker bents, and to do this, it was necessary to shorten the boom of the derrick car to 42 ft. The column sections were unloaded from the low-level construction track, placed on carriages and run out on a trestle parallel to and 9 ft. west of the center line of the rocker bent. As nine strands of ¾-in. wire cable were required for the load line of the derrick, it was impossible to get sufficient line on the drum to reach the members 115 ft. below base of rail. A 70-ft. loop of ten strands of ⅝-in. cable was provided, passing over a 50-ton hook on the end of the load line and through an erection casting at the bottom. This casting, when lashed to the column section, prevented the lines from cutting and at the same time allowed the member to be swung to the correct batter. To guard against any outswing while lifting these heavy members, the derrick car track was temporarily curved out so that the end of the boom was nearly over the load with the boom on the center line of the car.

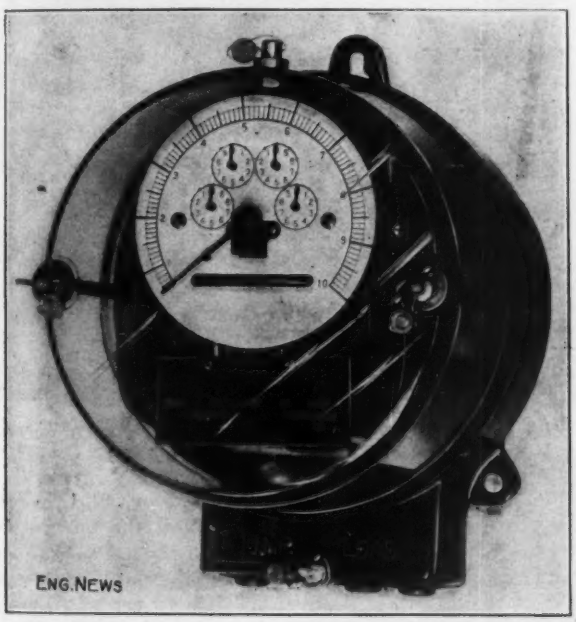
The maximum tonnage erected in one day with both derrick car and traveler amounted to approximately 200 tons. Not a single fatality and no serious accident occurred during the work. Ground was broken July 10, 1912, and the last span of steel was completed July 12, 1913. The viaduct was designed in the engineering department of the Chicago, Milwaukee & St. Paul Ry.; C. F. Loweth, Chief Engineer; J. H. Prior, Engineer of Design. The entire construction was carried out by the forces of the railway company, with E. H. Howell in charge.

The Death Rate of the Registration Area of the United States in 1913 was 14.1 per 1000 estimated population, according to a statement prepared by Dr. Cressy L. Wilbur, Chief of the Division of Vital Statistics, Bureau of the Census, Washington, D. C. This figure is based on 890,823 deaths returned from 24 registration states, the District of Columbia, and 41 registration cities in non-registration states. The total estimated population (as of July 1, 1913) in these states and cities was 63,299,164 or 65.1% of the population of the United States. The average death for the period 1901-05 was 16.2, and for 1906-10 it was 15.1. The 1912 death rate was 13.9, or 0.2 lower than that for 1913. By states, the 1913 death rates ranged from 17.1 for New Hampshire to 8.5 for Washington. The decline from the average death rate of 1901-05 to that of 1913 was 13% for the whole registration area; 15.7% for Rhode Island, 12.3 for New York, and 11.2% for New Jersey. Michigan showed an increase of 4.5%, and New Hampshire 3%. Among cities of over 100,000 population in 1910, there were declines of 24.7% in New York, 23% in Newark, and between 21 and 20% in San Francisco, Lowell, Spokane, Denver and Paterson, in the order named. Of the 50 cities in the over 100,000 class, only 12 showed increased death rates in 1913 as compared with the average for 1901-05. The five highest of these were: Omaha, 20%; Detroit, 15.6; Minneapolis, 13.7; Toledo, 13; St. Paul, 10%. It should be understood that all the death rates given are crude; that is, not corrected for disparities in distribution of population by age and sex.

A Combined Recording Electric-Energy and Maximum-Demand Meter

Since the wider acceptance of two- and three-part rate bases in the supply of electric energy from central stations, involving the measurement or estimation of the maximum load of each customer, demand has increased for a combined instrument to record both peak load and total energy. To meet this need, the Westinghouse Electric & Manufacturing Co., East Pittsburgh, has recently developed such an instrument resembling the familiar watt-hour meter and without more delicate parts. This is shown in the accompanying figure; it is installed like the ordinary watt-hour meter, requiring no additional apparatus or wiring. There is, besides the usual dial circles, a large circular scale with a pointer sweeping over it to indicate kilowatts load.

The mechanism includes a standard alternating-current meter movement (electromagnet, permanent magnet and aluminum disk on spindle). In addition, an auxiliary-disk sector is supported on jewel-and-ball bearing to move in the air gap of the electromagnet. Motion is restrained by a spiral spring so that the final deflection is proportional to watts drawn, as with an ordinary



COMBINED RECORDING-ENERGY AND MAXIMUM-DEMAND METER

indicating wattmeter. The auxiliary-disk shaft is geared to an escapement wheel, the claw of which is oscillated by an eccentric on the main-disk shaft; therefore the auxiliary disk can advance only at a rate proportionate to the speed of the main-disk shaft and therefore proportional to the load. This gives a fixed time of recording the maximum demand under all loads; for the greater demands the pointer has to travel farther but the main-disk shaft travels faster and equilibrium is reached in the same time. When the load varies so rapidly that time is not given for recording the actual maximum (ordinarily 15 minutes), the reading is that of the average load during the interval.

The auxiliary-disk shaft engages with the demand pointer through a dog; the pointer is held, by rachet and pawl, at its maximum reading while the shaft and disk retire to each lower point of equilibrium. The pointer is reset by the visiting meterman who presses a sealed button on top.

International Railway Fuel Association

The sixth annual meeting was held at the La Salle Hotel, Chicago, May 18-21, with a large attendance and a good display of exhibits of machinery and apparatus for the mining of coal, and its handling and combustion in locomotive service. The meeting was opened with prayer, after which the president, Mr. Collett (Frisco Lines), gave a short address. An address by Dr. Goss, Chief Engineer of the Committee on Smoke Abatement and Electrification of Railway Terminals, of the Chicago Association of Commerce, dealt with some of the work under his direction; then taking a cube block representing a pound of coal, he reviewed the work which this coal will do under various circumstances, and closed with the peroration that "if we take care of the pounds, the tons will take care of themselves."

COALING STATIONS—The report of the Committee on Coaling Stations reviewed the questions of design and capacity. It recommended reinforced-concrete and steel construction, but with steel supports, and all storage parts in contact with the coal to be protected by reinforced-concrete slabs. The committee did not think it necessary to have a separate department in charge of coaling stations, but it recommended that more attention should be given to the maintenance and operation.

The report did not favor the weighing of coal in the hoppers of the coaling stations, but during the discussion it was explained that this was not due to unreliability of apparatus, but rather to the unfavorable conditions under which such apparatus is operated at coaling stations. These include the rough handling, the difficulty of keeping the parts in proper adjustment for accurate work, and the fact that the class of men employed cannot be relied on for accurate work or the proper keeping of records. The labor difficulty would be obviated by the use of automatic apparatus, but whether the results would be worth the cost is a matter for the railways to consider.

A member from the Baltimore & Ohio R.R. stated that at points where coal is taken directly from the mine to the coaling station, a larry car of 1-ton capacity is used, and is weighed in transit. Measuring devices are used also, in place of weighing devices, and can be built and maintained at low expense. Bins of 2 tons and 4 tons capacity are used, and 20 tons can be loaded in 5 minutes. A special chute delivers the coal vertically over the center of the tender. As to the use of track scales, this is not sufficient for coaling-station records, as there is always a loss (by theft and spilling) between the car and the hopper, which would have to be charged against the locomotives. It was pointed out incidentally that there is a marked increase in the use of track scales for general work, and in the amount of attention to the maintenance of such scales in condition for giving accurate weights.

OTHER SUBJECTS—An interesting paper on "The Storage of Coal" was read by C. G. Hall (C. & E. Ill. R.R.), reviewing the present hand-to-mouth methods of mining, marketing and purchasing coal, with its attendant troubles in the way of labor, traffic congestion, shortage of cars, etc. His proposed remedy was the establishment of large storage yards of 100,000 to 500,000 tons capacity at distributing centers, with suitable machinery for unloading and loading the coal. The general scheme was approved by several speakers. In a paper on "The Sizing of Coal," Mr. Kinyon (Engineer of the Clinchfield Fuel Co.) pointed out the importance of using sized coal in locomotives, but stated that accurate information as to the cost and economy of sizing is not available.

In a paper on "Honeycomb and Clinker Formation," Prof. Parr (Univ. of Ill.) attributed the formation largely to chemical conditions and an excess of fine material in the coal, but most of the railway men seemed to consider that the methods of firing and working the engine were the larger contributing causes. A paper by Monro B. Lanier (Monro-Warrier Coal & Coke Co.) on "Heating Locomotive Boiler Feed-Water," described some forms of feed-water heaters used on ordinary engines and the heater which forms an extension of the boiler barrel on large Mallet locomotives. A paper by M. C. M. Hatch discussed "Relation of Front-End Design and Air Openings of Gates and Ash Pans to Fuel Consumption and Sparks." A paper which called forth considerable discussion in regard to fuel economy and the importance of records was "A Uniform Method of Computing Locomotive Fuel Consumption for Office Statistics and Trip Performance," by C. F. Ludington (A. T. & S. F. Ry.)

Other matters dealt with were as follows: "Coal Space and Adjuncts of Locomotive Tenders," L. R. Pyle (Soo Line); "Economies in Roundhouse and Terminal Fuel Consumption," by F. W. Folz (Mo. Pacific R.R.); report of Committee on Firing Practice," presented by D. C. Buell (Educational Bureau, Harriman Lines).

Officers were elected as follows: President, D. R. Mac Bain (L. S. & M. S. Ry.), Cleveland, Ohio; Secretary, C. G. Hall (C. & E. I. R.R.), 922 McCormick Bldg., Chicago. The next meeting will be held at Chicago in January, 1915.

Condition of the Interior of a 48-In. Riveted-Steel Water Main after 17 Years' Service*

When the 48-in. riveted-steel water main from the High Hill Reservoir of the New Bedford, Mass., waterworks was laid in 1896 there were very few reliable data upon which to base the probable life of a steel pipe line. Previous to this installation, the comparative merits of steel and cast-iron pipe were subjects of much discussion by the New Bedford Water Board with their constructing engineers, George S. Rice and George E. Evans, who finally convinced the Board that the cost of the steel pipe would be about 28% less than that of cast-iron pipe of the same size, and that the steel pipe would have an assured life of at least 25 years. Thus the city could well afford to replace the steel pipe every 25 years rather than pay the extra cost of installing the cast-iron main.

That this has proved to be a very wise decision is now confirmed in the opinion of Thaddeus Merriman, Assistant to the Chief Engineer of the Board of Water Supply, New York City, Leonard Metcalf, of Metcalf & Eddy, Consulting Engineers, Boston, Mass., Geo. H. Nye, City Engineer of New Bedford, and R. C. P. Coggeshall, Superintendent of the New Bedford Water Works, who examined this pipe in May, 1913. They found it to be still in excellent condition; the interior conditions were such that a long life was still in sight. The pitting of the steel upon the interior surface instead of advancing by penetrating the steel more deeply was found to some extent at least to be active in spreading itself out over somewhat larger areas and to lesser depths. With this 17 years' experience, it was easy to prophecy its reliability and usefulness for many years exceeding the 25-year limit.

The pipe was previously inspected in 1901 and in 1908. At the recent inspection, the internal and external conditions were found to be much as they were in 1908.

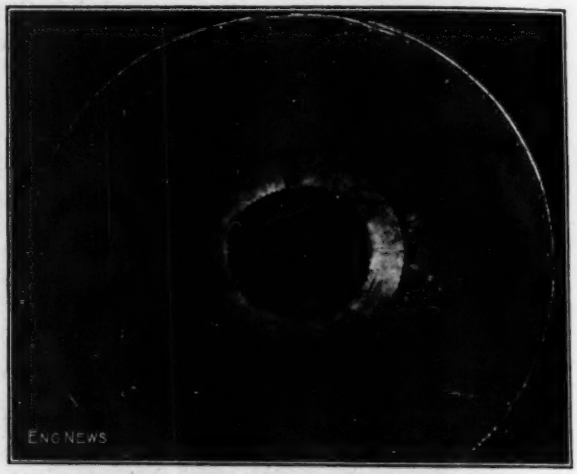


FIG. 1. INTERIOR OF THE 48-IN. RIVETED-STEEL WATER MAIN WHEN INSTALLED IN 1896

Fig. 1 shows the pipe as it looked in May, 1901, before any tubercles had formed. Fig. 2 shows the interior in May, 1908, and Fig. 3 in May, 1913.

The number of tubercles upon the interior surface was estimated in 1908 to range from 3 to 70 per sq.ft., with very few plates showing the larger number. There has been since a probable increase of from 10 to 20%. The pittings beneath the tubercles had not grown materially deeper by May, 1913, and the tubercles had not, so far as could be judged, increased very greatly, either in size or in numbers.

The average depth of the pittings now ranges from 0.075 to 0.090 in. The deepest one found was 0.110 in., which is no deeper than one found five years before. The thickness of the steel plates is $\frac{5}{16}$ in., or 0.312 in. The extreme pitting thus scarcely exceeds one-third of the thickness of the steel, and this pipe has now been in constant service for 17 years.

The interior of the pipe was found plentifully lined with blisters as well as tubercles, as can be seen by the

*Based on the Annual Report of the Water Board of New Bedford, Mass., for the year ending Dec. 31, 1913. Photographs from R. C. P. Coggeshall, Superintendent of the Water Board.

accompanying photographs. The blisters, however, far outnumbered the tubercles. The number of blisters had somewhat increased within the five years. In a way, it is the opinion of the engineers, that the blisters helped to protect the steel, for there was seldom any trace of rusting found upon the steel beneath them. Under the blisters the steel was generally sound and smooth and in most instances the mill scale, or coating of magnetic oxide of iron formed during the rolling of the plate, was intact. The water held by these blisters was of an alkaline nature, but not as alkaline as it was five years previously. Occasionally, under the blisters, rust was beginning to appear, but not sufficient to affect the surface of the steel.

These blisters are of all sizes up to 2 and 3 in. in diameter. A sample of water from between these blisters was taken, and analyzed with the result herewith presented (No. 1):

ANALYSIS OF WATER—Sample No. 1—The water as received was strongly alkaline to litmus.

	Parts per million
Total solids	637
Loss on ignition	164
Mineral residue	473
Alkalinity	518
Lime CaO	trace
Chlorine, Cl	trace
Sulphuric anhydride SO_3	31

Sample No. 2:

	Parts per million
Total solids	1998
Loss on ignition	516
Mineral residue	1482
Alkalinity	1614
Lime, CaO	trace
Chlorine, Cl	30
Sulphuric anhydride, SO	55

The ignition was attended by darkening, indicating the presence of some organic matter. Alkalinity due to fixed alkalies, hydrates and carbonates of sodium and potassium was determined by titration with $^1/_{50}$ normal acid.

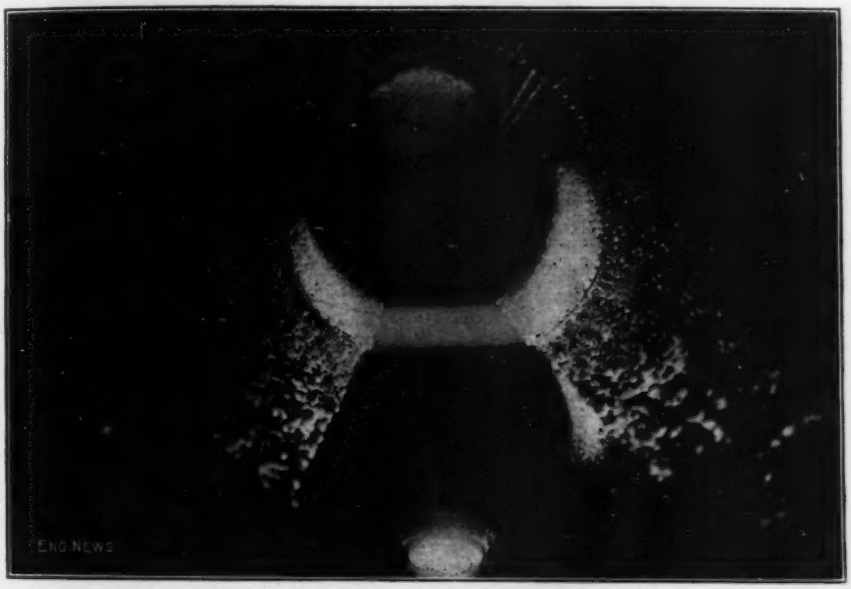


FIG. 2. INTERIOR OF 48-IN. RIVETED-STEEL WATER MAIN, NEW BEDFORD, MASS., FROM A PHOTOGRAPH TAKEN IN MAY, 1908; AFTER 12 YEARS' SERVICE

(This water main was described by Geo. S. Rice in a paper read before the New England Water-works Association in January, 1899. It is 8 miles long, of $^5/_{16}$-in. plates, coated with asphalt. About 1½ miles of the pipe is supported over a swamp on piles.)

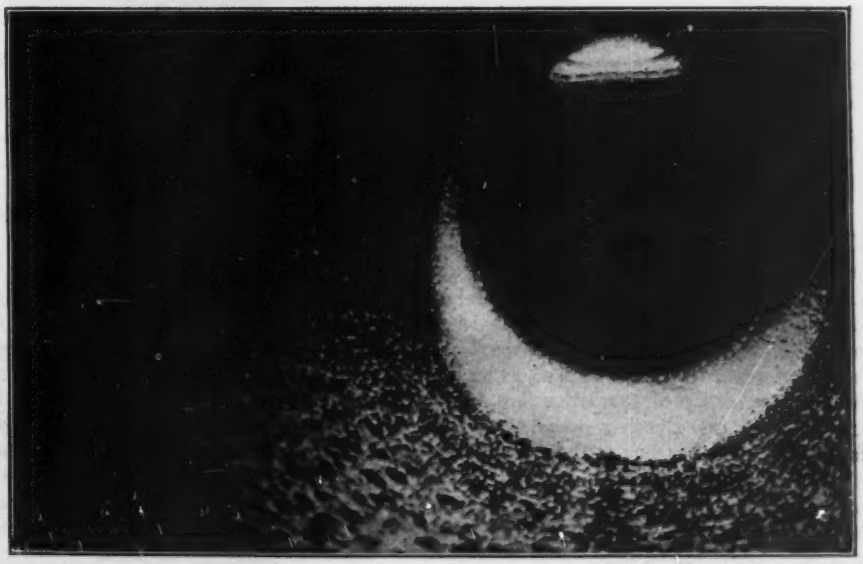


FIG. 3. INTERIOR OF PIPE FROM A PHOTOGRAPH TAKEN IN MAY, 1913; AFTER 17 YEARS' SERVICE. AVERAGE DEPTH OF PITTINGS 0.075 TO 0.090 IN. NO PITTINGS DEEPER THAN ONE FOUND IN MAY, 1908.

(No tubercles were found deeper than 0.110 in., or about one-third the thickness of the plates. Blisters ranged from 2 to 3 in. in diameter, and these probably help in protecting the steel from corrosion.)

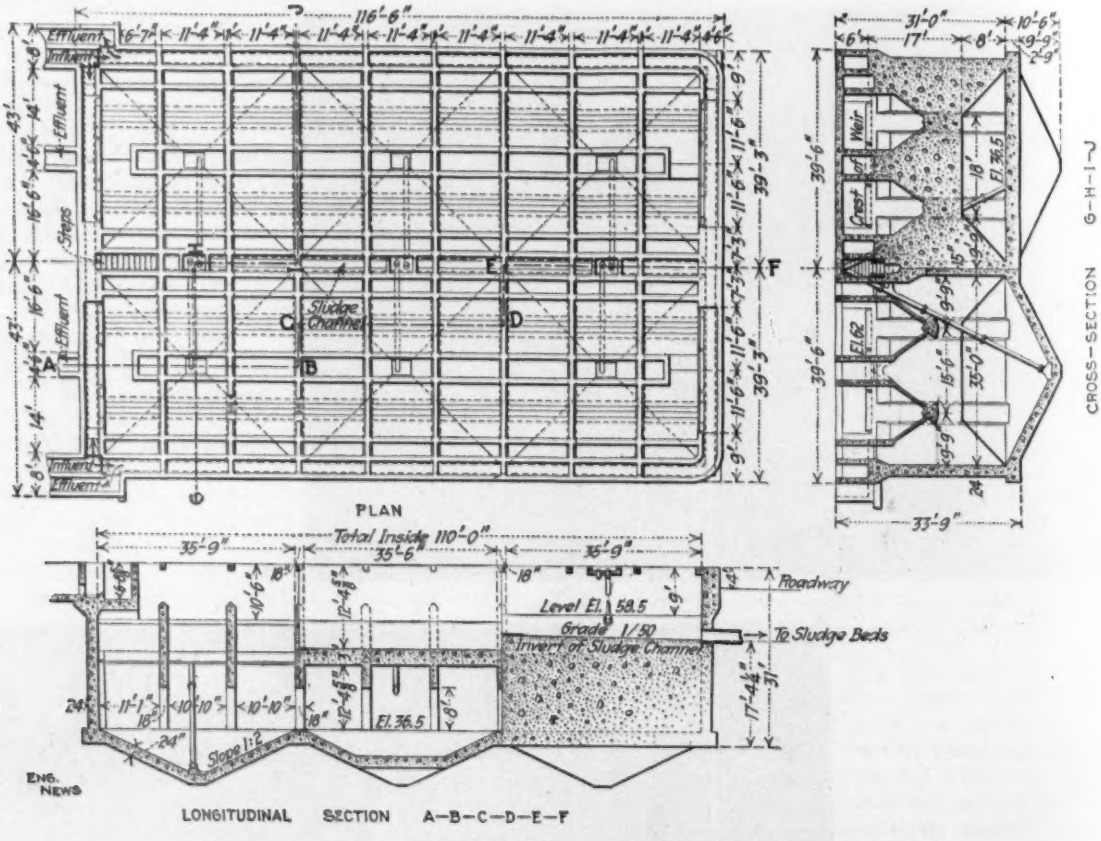
Another section of the pipe was examined in May, 1908, and again in October, 1909. The conditions at the recent inspection in May, 1913, were found to be generally similar to those at the time of the 1909 examination, although it was made quite certain that the number of blisters has been increasing while the number of tubercles had remained practically constant as to numbers. The deepest pitting was found to be 0.112 in., which showed no increase over the extreme depth found five years before. A sample of water from behind the blisters was taken and the analysis is given as Sample No. 2. Here were found frequent small patches of spongilla, none of which were seen in the first section of pipe examined. Later in the season, these patches would be found very much larger in all parts of the pipe.

The inside asphalt coating in the pipe was found to have lost most of its original elasticity, but the facts that new blisters have formed and that old ones have increased in size seemed to indicate that some elasticity still remained and that the coating was still of value as a protection to the steel. Walking through the pipe broke this coating up, and there seemed to be no question that the less it is disturbed the better it is for the pipe. It is probable that the carrying capacity of the pipe has not changed much from that at the time of the two previous examinations, but this is due to the low velocity of flow through it. In the various places where the outside coating was examined it was found to be very smooth and in excellent condition.

Sewage-Treatment Works for Rochester, N. Y.

Bids for the construction of ten Imhoff sewage-clarification tanks, or half of a proposed installation for a population of 400,000, were received by the City of Rochester, N. Y., on Mar. 18 (see our Construction News section, Apr. 2, 1914, p. 205, for detailed bids). The general design of these tanks is shown by the accompanying drawings, which represent a pair of tanks, or a tenth of the installation.

The full sewage-disposal scheme for Rochester consists of (1) an intercepting sewer, partly in tunnel and partly in open cut within the city limits, designed to take the sewage and an additional 2½ volumes of storm water from all the sewers now discharging into the Genesee River; (2) an outfall sewer from the end of the intercepting sewer at the city limits to a point near the lake shore, about two miles east of the Genesee River;



DETAILS OF IMHOFF TANKS, ROCHESTER SEWAGE-TREATMENT PLANT

(3) 6 detritus tanks, 10 ft. wide and 90 ft. long; (4) 20 Imhoff tanks, 35 ft. wide, about 110 ft. long, and about 40 ft. deep; (5) sludge-drying bed of over 13,000 sq.ft. area; (6) a 5½-ft. steel effluent-discharge pipe, extending 7000 ft. from the lake shore into water 50 ft. deep; (7) a light and power house.

The plans for the disposal plant as a whole have been approved by the Department of Health and the Conservation Commission of New York State, and the effluent-discharge pipe has been completed. As already stated, bids for building 10 of the 20 Imhoff-tank units were

received on Mar. 18, with the understanding that 4 more units might be ordered for construction in 1915. Other contracts will be let at a later date. The bids for the ten tanks ranged from $333,855 (Meyers & McWilliams, Pittsford, N. Y.) to $449,488. The contract was let to the lowest bidder on April 22. The engineers's estimate was $376,940.

The design of the Imhoff tanks, shown by the accompanying drawings, is the result of an extensive investigation made by Emil Kuichling, of New York City, consulting engineer for the disposal works. The sludge space, and also the gas vents for these Imhoff tanks, is much larger than usual.

The plans for the Rochester sewage-disposal works were prepared under the direction of Edwin A. Fisher, until recently city engineer and now consulting engineer to the City of Rochester. We are indebted to Mr. Fisher for the information here given.

The Largest Steam Turbines and Surface Condensers; New Station of the Philadelphia Electric Co.

It has been known for many months that the largest steam turbines yet built or designed and the largest stationary surface condensers were to be placed in an extension of the Christian St. station of the Philadelphia Electric Co. (as noted in ENGINEERING NEWS, Aug. 14, 1913, p. 324). The work on the turbines, condensers and on the new station itself has progressed to such a point that the important features of design are now disclosed and the appended items are of timely interest.

The business and stations of the Philadelphia Electric Co. offer many features of general engineering interest. Besides carrying the usual load of such a plant—light and power for the metropolitan and suburban districts, it supplies current to further outlying areas, to the city street-railway system, and it now has taken contracts to supply the energy demanded by the Pennsylvania R.R. for its electrified terminal zone. This whole territory is some 40 miles long by 15 wide.

There are now in operation three generating stations and a "stand-by" emergency plant; a fifth station is under construction. This last will house the new apparatus of record size. These several plants provide 25-cycle current for railroad and street-railway supply and 60-cycle current for general light and power.

NEW STATION—This plant is at 28th and Christian St., adjoining the company's main plant. The building is 188x262, and is quite like the older structure in appearance but cut off from it by permanent walls. The two from the outside have the appearance of one. Condensing-water intake and discharge tunnels form the only mechanical connection between the old and new plants, though the electrical control of both is unified.

There will be in the new plant, besides control equipment for the two new units, switching apparatus for the three 15,000-kw. turbines in the old main station; further, a frequency-changer station nearby will be controlled from here over a tie line. This concentrates the control of 119,000 kw. Separate operating rooms will be maintained in the twin stations but there will be constant telephonic communication and large glass windows will enable the switchboard operators to see each other.

The generating equipment of the old and new plants will be entirely independent even to boilers, auxiliaries and coal bunkers.

TURBINES—Two turbine-driven alternating-current generators with auxiliaries, etc., will comprise all the new equipment. One is the 35,000-kw. (60-cycle) unit already noted and the other is a 30,000-kw. (25-cycle) machine

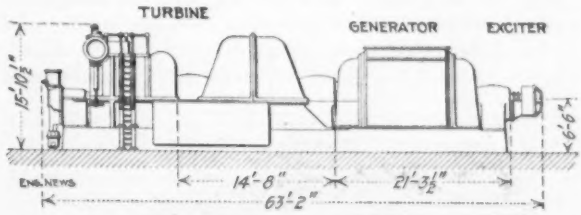


FIG. 1. OUTLINE ELEVATION OF 35,000-KW. STEAM-TURBINE ELECTRIC-GENERATING UNIT FOR THE PHILADELPHIA ELECTRIC CO.

of similar design and nearly the same dimensions. The general outline (elevation) of the larger machine is shown in Fig. 1. The comparative dimensions are given in the accompanying table. Steel and concrete foundations have been used with a sub-base on bedrock. Both turbines will take steam at 215 lb. gage pressure (at the throttle) and superheat of not more than 200° F. An exhaust (condenser) pressure of 1½ in. mercury is designed for. The main bearings (24 in. diameter by 52 in. length) will be water cooled by circulation of 60 and 100 gal. per min. for the 30,000- and 35,000-kw. machines, respectively. For the lubrication of both units, 40 gal. per min. of oil will be circulated—there being a 15-gal. tank, cast in the base of each machine, a geared pump and a reserve steam pump. Clean oil is supplied to these tanks by a gravity filtering and cooling system. The generators are both of horizontal revolving-field type, generating directly at 13,200 volts for distribution without step-up transformers. The larger machine has six poles, rotates at 1200 r.p.m. and carries on an outboard bracket a direct-connected 150-kw. 250-volt shunt-wound exciter. The smaller machine has two poles and a speed of 1500 r.p.m.; its exciter, similarly carried, is a 110-kw. 250-volt shunt machine. In addition to the direct-connected exciters, there is a 500-kw. exciter driven through reduction gear by a steam turbine (speed ratio 5000 to 900).

A feature of the large generators is the use of temperature coils permanently located in the stator windings and connected to switchboard instruments to show temperatures of the high-tension windings. Cooling air is secured by an induced-draft system, there being an in-

PRINCIPAL DIMENSIONS AND RATINGS OF 35,000-KW. AND 30,000-KW. TURBO-ALTERNATORS OF THE PHILADELPHIA ELECTRIC CO.

Turbine	Length overall	Extreme width	Extreme height from floor	Weight, lb.	Speed, r.p.m.	Diam. throttle valve, in.	Size exhaust outlet, ft.	Diam. free exhaust, in.	Steam consumption in lb. per kw.-hr. (215 lb. 200° F., superheat, 1½ in. condenser)
30,000 kw. (25-cycle)	59 ft. 4½ in.	19 ft. 8 in.	15 ft. 2 in.	975,000	1500	18	14x12	36	12.45 lb. at 15,000 kw., 11.9 lb. at 22,500 kw., 12.75 lb. at 30,000 kw.
35,000 kw. (60-cycle)	63 ft. 1½ in.	21 ft. 5 in.	15 ft. 10½ in.	1,200,000	1200	20	14x12	36	12.9 lb. at 15,000 kw., 11.9 lb. at 25,000, 12.0 lb. at 30,000, 12.6 lb. at 35,000 kw.

dependent air washing and cooling plant for each unit; 60,000 and 85,000 cu.ft. per min. are furnished to the two generators.

CONDENSERS—Each is a two-pass counter-flow surface type having 50,000 sq.ft. of cooling surface—1 in. 18-gage tubes of special composition. The arrangement of steam and water paths is novel. The tubes are arranged in concentric circular rows, with the whole group placed eccentrically in the shell to give a surrounding steam space of diminishing cross-section. Cooling water enters through a 48-in. pipe at the bottom and discharges at the top through a similar pipe. The discharge is sealed to give a siphon system reducing the work of the circulating pump to that of overcoming friction of tubes and pipes. In accordance with the Philadelphia company's practice, the condensers will have auxiliary piping and motor-operated valves to bypass part of the circulating water and flush out leaves, etc., which may have passed

FIG. 2. STATOR CASTING FOR 35,000-KW. TURBINE-DRIVEN ALTERNATOR

the forebay screens; also to facilitate cleaning, swing doors with hinged bolts are used in place of the usual cover-plates.

The condensate trickles down over the hottest tubes and is removed at about exhaust-steam temperature. The air outlet is in the center of the tube group to give the steam and gases a minimum length of flow through past the tubes. The air pumps are of the Leblanc (water-jet) type, turbine driven and placed immediately below the condensers. The water needed by it is taken from the circulating pumps and thrown into the discharge tunnel.

For each unit there will be two tri-rotor centrifugal pumps with geared-steam turbines (speed ratio of 2880 to 320). Each has a capacity of 37,500 gal. per min. A spare unit of the same type and capacity can be used with either condenser. Each condenser has also two two-stage condensate pumps (1500 gal. per min.) turbine driven. From an equalizing tank, condensate flows to an open feed-water heater.

The water-supply comes from the Schuylkill River in the old 10-ft. intake tunnel, given a 7½-ft. extension. Some 110,000 gal. per min. will be required for all summer load and this will create a current velocity of 6 ft. per sec. in the intake. At the forebay is a motor-driven revolving screen and heavy ice racks.

BOILERS—The new steam raising equipment will consist of 20 water-tube boilers with superheaters. Each is guaranteed to evaporate 60,000 lb. water per hour from 160° F. to 250 lb. and 600° F. Each will have recording steam-flow and CO_2 meters, recording thermometers for the flue temperatures, etc.

The boilers will be in four rows of five each, with 5-ft. alleys between. Two rows will feed each turbine. Each row will have a steel stack 19-12 ft. in diameter and extending 207 ft. above floor line and supported by the steel frame of the building.

Each boiler will carry a ten-retort underfeed stoker with extension grate and clinker crusher; ashes go into a hopper below the furnace. For each furnace there will be one multivane blower driven by a 60-hp. geared steam turbine (3600 to 510 speed ratio). Some 35,000 cu.ft. of air per minute maximum will be delivered against a pressure of 5 in. water. These blower turbines are guaranteed to have a steam consumption of not over 28 lb. per b.hp.

The stokers for each row of boilers will be driven from one line shaft by chain belts; the shaft is driven, through a variable-speed transmission, by a 60-hp. geared steam turbine. It is proposed to run the boilers at from 125% to 250% normal rating; stokers of one row in each turbine unit, will be run at constant speed for most economical output while the speed of the stokers on the other boiler row will be varied according to load.

Coal can be brought in by rail or river barge though 90% comes now by water. At the near-by coal dock is one team and one electric tower having a combined capacity for unloading, crushing and weighing 300 tons per hour. Coal is conveyed to the station by a cable road hauling 3-ton cars, which dump into track hoppers. The fuel is elevated to the top of the boiler house and there distributed to the bunkers.

Partial List of Important Existing Wood-Stave Pipe Lines—The following list was compiled by Haviland, Dozier & Tibbetts, Civil Engineers, San Francisco, Calif., and is printed in an appendix to their recent report on a proposed water supply for the Richmond Municipal Water District, Richmond, Calif.:

Location	Constructed	Diameter, inches	Length, miles	Maximum head, feet
(a) Manchester, N. H.	1874	72	0.1	38
Denver, Colo.	1889	30	20.0	185
Provo, Utah	1891	14	3.7	...
Butte, Mont.	1892	24	9.0	202
Astoria, Ore.	1895	18	7.5	175
St. Paul, Minn. ..	1896	42	1.5	...
Los Angeles, Calif.	1896	30	7.5	105
Ogden, Utah	1897	72	5.1	117
Los Angeles, Calif.	1898	14	7.5	...
Lynchburg, Penn.	1906	30	18.5	...
Madison River Power Co., Mont.	1906-8	120-144	3.0	25
Tumwater, Wash.	1909	102	2.1	170
Vancouver, B. C.,	1910	30	4.3	210
Atlantic City, N.J.	1911	48	7.0	173
Pueblo, Colo.	1911	84	3.5	...
Mohawk Hydro-electric Co., N.J.	1911	78-96	2.0	160
Pac. Gas & Elec. Co., Calif.	1913	96	...	...
(b) Madison River Power Co., Mont.	1913	156	...	...
(c) Chicago, Milwaukee & St. Paul Ry., Wash.	....	38	0.2	400

(a) First pipe constructed. (b) Largest pipe. (c) Greatest pressure.

Editorials

In these times when railway and building work is stagnant, it is of interest to the engineering profession to know that work on various enterprises for municipal sanitation is quite active. In the State of Ohio, three large cities within 60 miles of each other are at the present time receiving bids for the construction of sewage-disposal plants. The three cities referred to are Canton, which opened bids for its plant on May 26; Akron, where bids will be opened on June 16, and Cleveland, where a plant to purify the sewage of about one-sixth of the city is to be built and bids for it are to be opened about July 1.

While the three plants have the same consulting engineer, R. Winthrop Pratt, of Cleveland, the three plants to be built represent three different types of construction. In Canton, sedimentation tanks and contact beds are to be used; in Akron, sedimentation tanks and sprinkling filters; while at the Cleveland plant, grit chambers and fine screens are to be tried at the start. The screens, it is well to state, are an experimental installation and will only be paid for when the guarantee made by their manufacturers is fulfilled.

Those who have reached the conclusion that the way out of the Mexican tangle is for the United States to undertake to govern that revolution-ridden country would do well to read and ponder the report just made by Secretary Lane, of the Interior Department, to Congress regarding the sort of government which the United States is now furnishing to its territory of Alaska.

It is pretty well known that the inhabitants of Alaska, with one unanimous voice, utterly condemn the manner in which the settlement of Alaska and the development of its natural resources is at present throttled by governmental red tape. Secretary Lane urges a plan for the government of Alaska under which a commission of three appointed by the President would take over all the multifarious duties now scattered among a score of government departments at Washington. Anyone who will read the detailed story given in Secretary Lane's report of the method by which Alaskan development is hampered by governmental methods must feel very dubious indeed concerning the proposition that the United States should assume further responsibilities for carrying on government outside its own borders. It is of interest to note that we have succeeded much better in governing the Panama Canal Zone and the Philippines than in governing Alaska. In both Panama and the Philippines, however, we succeeded because the plan adopted placed responsibility in the hands of a resident commission and we did not attempt to carry on the government by bureaus at Washington. It may be added that in the early days of United States control at Panama, when it was actually attempted to run affairs on the Isthmus from a Washington headquarters, the result was chaos.

Reopening of the Railway-Gage Question in Australia

The struggle over the question of a uniform gage for the railways of the Australian Continent which was thought to be settled a year ago by the report of a board of expert engineers in favor of a standard gage of 4 ft. 8½ in. has unfortunately been renewed. At a conference of the Premiers of the Australian colonies, held in Melbourne on Apr. 4, controversy over the gage question broke out anew. It should be understood that each of the colonies has its own system of railways already created upon a certain gage. A discussion which lasted four hours was finally concluded by the adoption of the following motion:

> The States hereby agree to refer to the Interstate Commission the question of a uniform railway gage for Australia, to report whether it is desirable to adopt a uniform railway gage, and, if so, when and what gage should be adopted. And further, that the Commonwealth and the States agree to refer to the said commission the following questions: (1) What benefits will result (a) to the Commonwealth, (b) to each of the States? (2) What would be the cost of the conversion? (3) In what manner and to whom shall such cost be apportioned?

Unfortunately, the Interstate Commission on which the responsibility is now laid is made up of laymen; and we are informed it has no authority or means to engage the services of expert advisers, but will be restricted to the hearing of local evidence. The danger is, therefore, that the question may be decided not on the basis of what is for the ultimate interest of Australia as a whole, but which of the colonies can exert the largest influence to secure a decision in favor of the gage in use on its particular railway system.

Conservation Wounded in the House of Its Friends

As our older readers at least will recall, ENGINEERING NEWS was among the pioneers in the movement for the intelligent conservation of natural resources and it has used its influence in every way possible to have this important movement conducted on sound engineering principles.

We regret to say, however, that in some cases, the Conservation movement has been injured by excess of zeal and lack of discretion on the part of its leaders. An illustration is before us in a report of the Board of Directors of the National Conservation Association dated June 1, 1914. Under the heading "Coal Legislation in Congress," the report says:

> One of the important victories for Conservation to which your Association contributed in no small part was the defeat of the Republic Coal Bill (S. J. Res. 41), introduced by Senator Myers, of Montana. This bill would have granted to a private corporation, the Republic Coal Co., a subsidiary of the Chicago, Milwaukee & St. Paul Ry. Co., more than 2000 acres of coal lands, officially estimated to contain 10,000,000 tons of high-grade coal. The appraised price fixed in the

bill was about $82,000. On investigation, it developed that this coal would be worth about $30,000,000 to the grantee.

A brief and nontechnical arithmetical computation shows that at the value of $30,000,000 fixed by the "investigation," the coal lying unmined in its natural state would be worth an average price of *$3 per ton!*

Nowhere in the world that we know of is unmined coal valued at any such preposterous figure or anything like it. Even in the Pennsylvania anthracite field, the royalties paid by the coal-mining companies to the land owners run usually, we believe, below 30 to 50c. per ton as the highest figure. In the best soft-coal fields the usual royalty is 8 to 12c. per ton. We know of no instances of any higher royalties being paid in the Northwest.

It may be, very likely, that the $82,000 sale price was too low a figure, and that a lease of the coal field at a fair royalty per ton would have been better for both the public and the coal company. But to claim that 10,000,000 tons of soft coal in the seam is worth $30,000,000, brands those responsible for such a claim as impracticable dreamers; and what is most unfortunate of all, tends to discredit the Conservation movement in the minds of practical business men.

The International Engineering Congress

The International Engineering Congress, which is to be held in connection with the Panama Pacific Exposition from Sept. 20-25, 1915, is of interest to a far wider circle of engineers than those who plan to visit San Francisco and take part in the Congress.

Those who have attended such international congresses, either those which attempt to cover the whole broad field of engineering or those of more limited scope, are aware of the difficulties which those who attend them find in dealing with the vast mass of material presented to the congress in the few days during which the sessions usually continue. What is really the more important function of such a congress is the making of a summary of progress.

It is expected to have presented before the International Engineering Congress at San Francisco papers covering the entire field of engineering development. As now planned, these papers are to be published in permanent form in ten separate volumes, classified as follows: Volume I, the Panama Canal; II, Waterways and Irrigation; III, Municipal Engineering; IV, Railway Engineering; V, Materials and Construction; VI, Mechanical Engineering; VII, Applications of Electricity to Engineering; VIII, Mining Engineering and Metallurgy; IX, Naval Architecture and Marine Engineering; X, Military Engineering and Miscellaneous Topics, including Engineering Education and Aëronautics.

Any engineer resident anywhere in the world can become a member of the Congress by payment of $5, and membership entitles the holder to all the privileges of attendance at the International Congress and also to the index volume of the proceedings of the Congress when published and any other one volume which may be selected by the subscriber.

That the Congress is really to be international in its character is indicated by the fact that subscriptions for membership have been received already from forty-six different foreign countries. In fact, about 30% of the entire subscriptions thus far received are from foreigners. The congress is to be held under the auspices of the five great national engineering societies of civil, mining, mechanical and electrical engineers and naval architects. Colonel Goethals is the Honorary President of the Congress. Wm. A Cattell, M. Am. Soc. C. E., Foxcroft Bldg., San Francisco, Calif., is the secretary of the committee having the preparations for the Congress in charge. Applications for membership may be addressed to him.

A Great Steamship Disaster in the Lower St. Lawrence

The worst ocean steamship disaster since the loss of the "Titanic" occurred May 29 in the lower St. Lawrence 200 miles from Quebec when the Canadian Pacific steamship "Empress of Ireland," one of the largest and finest vessels sailing from Canadian ports, was struck by the collier "Storstad" and sank in 14 minutes. The collision occurred at 2:12 a.m. in a dense fog. The total loss of life, according to the latest reports, was 934 persons and the number saved was 403. Credit must again be given to the wireless telegraph that the number saved was as large. Had it not been for the wireless calls for aid, sent out the moment the disaster occurred, and the prompt response of vessels near at hand, most of the ship's company who were left afloat when the vessel sank must have perished.

This terrible disaster furnishes new evidence of the perils to navigation on the St. Lawrence route, which have been frequently commented upon in these columns. A vessel sailing from Quebec must traverse nearly a thousand miles of the lower St. Lawrence River and Bay before she reaches the open ocean. During the summer season, particularly, when ocean passenger travel is at its height, dense fogs are prevalent in this region a large part of the time. While the river channel is broad and deep, the shores are rockbound and any ship getting out of its course in thick weather and going ashore is almost certain to be a total loss. The number of wrecks which have occurred along these shores during the past dozen years or more bear eloquent testimony to the risks attendant upon St. Lawrence navigation; but the public hears little of the disasters to the freight steamers which carry the world's commerce and it takes some such terrific loss of human life as has occurred on the "Empress of Ireland" to bring to public attention the serious nature of the danger.

We present this matter in no narrow spirit of advocacy of American ports over Canadian. As engineers it is our business to deal with facts solely, and not with matters of national or political prejudice. It is well known that in recent years the advantages of Montreal and Quebec as seaports in connection with the flow of the grain crop from the central West to Europe have diverted to them a great part of the wheat traffic that formerly went through the port of New York; but the advantage of the shorter route from the grain fields to Europe which the Canadian ports unquestionably offer is, partially at least, offset by the risks of that route. There has recently been a concerted attempt by some of the Canadian commercial organizations to organize a Canadian marine insurance company which would charge lower rates on ships navigating the St. Lawrence than the rates charged

by the present companies. This latest marine disaster furnishes only too convincing evidence that the underwriters are fully justified in charging higher rates on traffic over this northern route.

The early accounts of the disaster indicated that the two ships collided in a dense fog. The later reports indicate that the vessels sighted each other when a long distance apart.

The "Empress" had stopped at 1:30 to put off the pilot at Father Point. The "Storstad" when sighted was about two miles away and about one point (12°) on the starboard bow of the "Empress," the weather being then clear. Capt. Kendall of the "Empress" is quoted as follows:

> At that time I saw a slight fog bank coming gradually from the land, and knew it was going to pass between the "Storstad" and myself. The "Storstad" was about two miles away at that time. Then the fog came and the "Storstad's" lights disappeared. I rang full speed astern on my engine and stopped my ship.
>
> At the same time I blew three short blasts on the steamer's whistle meaning, "I am going full speed astern." The "Storstad" answered with the whistle, giving me one prolonged blast.
>
> I then looked over the side of my ship into the water and I saw my ship was stopped. I stopped my engines and blew two long blasts meaning, "My ship was under way, but stopped and has no way upon her." He answered me again with one prolonged blast. The sound was then about four points upon my starboard bow.
>
> It was still foggy. I looked out to where the sound came from. About two minutes afterward I saw his red and green lights. He would then be about one ship's length away from me; I shouted to him through the megaphone to go full speed astern, as I saw the danger of collision was inevitable; at the same time I put my engines full speed ahead with my helm hard aport, with the object of avoiding, if possible, the shock. Almost at the same time he came right in and cut me down in a line between the funnels.

The official statement of the "Storstad's" owners agrees with the above in that the "Storstad" sighted the "Empress" when the two vessels were far apart. The "Empress" was on the "Storstad's" port bow and her starboard light was showing. Shortly afterward the fog enveloped both vessels. The "Storstad" stopped her engines but continued under her own headway without altering her course until the "Empress was sighted through the fog close ahead, showing her starboard light. The engines of the "Storstad" were then reversed and her headway was nearly checked when the collision occurred. It requires, however, only very slight speed in a moving ship of large size to cause its bow to deal a fatal wound upon the hull of another vessel. The Captain of the "Storstad" claims that after the collision he started his engines ahead endeavoring to plug the rent in the side of the "Empress," but that the way on the "Empress" caused the two vessels to drift apart.

Putting the statements of the two officers together, it appears that the course of the "Empress" crossed that on which the "Storstad" was proceeding. The former vessel was doubtless turning out toward midstream, having just put her pilot ashore. The "Storstad" appears to have relied on her right-of-way to continue on her course without reversing her engines, notwithstanding the fog bank into which she ran, and notwithstanding the lights of the vessel ahead crossing her bows.

It is to be hoped that this great disaster will again direct public attention to the need of better measures for safeguarding vessels navigating in fog. Valuable as is the wireless telegraph for many purposes at sea, it appears to be of little or no aid when ships approach near enough to each other to be in danger of collision. When fog closes down over the water so that the view ahead and on either side is limited to distances of a few hundred feet, the navigator of a vessel must rely on sound alone to warn him of the approach of another vessel against whose impact he must be on his guard. The submarine bell appears to be so far the only instrument ever developed which promises to supplement, to some extent at least, the warning which sound may give of the approach of vessels to each other in a fog. This latest St. Lawrence disaster might well cause the Canadian government to undertake extensive experiments to determine the availability of submarine bells to furnish additional safeguards for the St. Lawrence navigation. If it can be established that additional safety could be secured by the use of devices of this class, the government would doubtless be within its right in making their use compulsory on all vessels navigating the lower St. Lawrence.

Letters to the Editor

Making Tight Joints in Sewers and House Connections

Sir—Your article relating to Sewer Pipe Joints on house connections, on p. 1138 of your issue of May 21, was of great interest to me. The original article of E. J. Fort in your issue of May 7, described joints under several feet of pressure, and these could hardly be handled by a concrete shell as suggested in your article; but the ordinary house connection can be easily and cheaply taken care of in this way.

The suggestion which I wish to bring forward, however, bears more on the labor employed in laying the house connections than on the materials used in making the joints. I have had occasion for the last five years to oversee the laying of sewer mains as well as the house connections and I thoroughly believe that the only way to be certain of tight joints is to have the company or department directly interested in the disposal of sewage have all pipes leading to the mains laid by its own foreman, who, if he is half a man, will under instructions make it his pet hobby and pride that all connections are made by himself and put clearly "up to him."

In this borough where we have around a thousand house connections with the sewers, the sewer laterals are all laid into the foundation of the house by the company's foreman. If for any reason the plumber lays his iron pipe through the wall, the foreman of the company must make the cement joint. The only safe and sure way to be certain that joints are properly made is to have

them all made by one man definitely charged with this duty and responsible for results. Where all sewage is pumped and filtered, percolation of ground water into the sewer is an accumulating expense and all leaks should be carefully guarded against.

RUSSELL H. PECK,
Engineer, Palmerton Disposal Co.
Box 282, Palmerton, Penn., May 26, 1914.

Highway Bridge Competitions

Sir—Your editorial in the issue of May 14, 1914, on "The Absurdities of Engineering Competitions" seems to need some explanation, as your information evidently was not complete.

The facts, in the main, are quite correctly stated, except for two very essential points. One of these points is that the council for the southern town was responsible for the condition that "Public sentiment was against holes in a bridge," and that ribbed arches were not desired. Your correspondent should have stated more correctly that the ignorance of the councilmen on such matters was used by one of the interested bidders to create that very sentiment in order to shut out the most meritorious design, and that the ribbed-arch designs were thrown out because they were more costly than the barrel-arch design.

The other point concerns the "building inspector from an adjoining city," who was called in to decide which design was the best. The fact of the case is that the "building inspector" called in was an experienced structural engineer, who has had charge of the design of some of the most notable reinforced-concrete bridges in the world and is fully competent to pass upon ordinary structures like this one at least.

On fact may be added, which was not stated, that there was a local consulting engineer appointed by this same council to act without salary. He could not have done this work for love of it. Who paid him? There is much food for serious thought in the fact that one who has never designed such structures could have been thus employed, to say nothing of the professional status of such a consulting engineer.

It is a matter to be much regretted that a highway bridge letting is the same log rolling, bullying process today that it has been for so many years. Let engineers notice, who are complaining, that when these practices are at last broken up, only those who have kept themselves above such policies will have survived the ordeal.

"PLAIN ENGINEER."

May 20, 1914.

Killing Teredos by Electricity

Sir—In regard to the earlier notes in your journal on the electrocution of teredos:

Electricity actually is being tried in this city (and I am informed quite successfully) for the purpose of destroying teredos, but electrocution is not the means of attaining this end. The teredo is destroyed through poisoning and suffocation; chlorine gas is liberated, by electrolytic action, from the salt contained in the water.

UDO HESSE.
304 Mutual Life Bldg., Seattle, Wash.,
May 9, 1914.

"Blowing-Up" of Wood-Block Pavements; Expansion Joints in Pavements

Sir—I note your editorial in the issue of May 14, p. 1085, in regard to an attempt to prevent the "blowing-up" of a wood-block pavement by saturating the blocks just before laying. As you have pointed out, it is a mistaken idea, and not based upon a knowledge of the real cause of the failures. It would probably make matters worse.

Block pavements "blow-up" when the upper part of the vertical joints are more completely filled than are the lower half, so that when the joints tighten up by swelling or expansion of the blocks, due to saturation or heat, there is not a uniform pressure on the vertical faces of the blocks; it may be all concentrated along the upper edge, which gives a lever-arm, causing tipping, followed by the "blowing-up."

The only real remedy is to construct the pavement with the joints, especially the lower half, completely and permanently filled. This is easily done with brick, but with a wood block it is probably more difficult to produce a permanent joint.

If the wooden blocks are laid when in their swollen state there will result a loose pavement as soon as the blocks dry out, joints will open permitting the edges to broom, sand and dirt to be pounded in, probably reducing its life. It certainly will have a tendency to leave the lower half of the joint loose, which by all means is to be avoided. It would be far better to make some effort to have the blocks in their minimum size when laid.

This subject is intimately connected with that of expansion joints of which much has been said, but as we look over the current specifications and plans for pavements it seems that there is still some difference of opinion.

In concrete roads the best present practice calls for transverse expansion joints about 30 ft. apart, while for brick pavements the cross joint has been practically discarded. When we stop and consider that in a well grouted brick road the filler is about as strong as the brick, if not more so, why there should be any difference in the use of transverse joints is a little strange, if not ludicrous. If expansion joints are needed in the one they are in the other.

Experience has shown transverse expansion joints are useless in brick pavements and experience will also show in time they are unnecessary in concrete roads. Concrete pavements crack, due to shrinkage and contraction, so also do the brick. These cracks are found to be 8 to 15 ft. apart in both kinds of pavements. In neither material is the tensile strength sufficient to take up the stress, but both withstand the compressive stresses. Then why should there be any difference in the details of construction in this respect?

When the cracks appear in the pavement, whether concrete or brick, they should be cleaned and grouted, and not filled with tar or other soft material as seems to be done at present. In this way a good, hard and nearly uniform surface will be obtained. The soft material permits the edges of the cracks to wear away.

I should also like to raise the question of what use is the longitudinal joint along the edge of a pavement? It is an observed fact that there is no lengthwise movement

of the pavement so they are not needed as a lubricant. The only use of any value is to protect a flimsy curb. A light curb set in only a sandbed may need the joint, but if the curb is properly built so as to be permanent, it will also withstand the pushing due to the expansion of the pavement.

O. M. SEVERSON.

511 Marine Bank Bldg., Erie, Penn.,
May 21, 1914.

Sir—I have read with much interest the editorial in ENGINEERING NEWS, of May 14, entitled, "Guarding Against Expansion in Wood-Block Paving." This interest was somewhat heightened by the fact that the writer has inspected the manufacture of 1,500,000 of the blocks to which reference is made in your editorial. With regard to this matter the following may be of interest:

In 1912-13 the writer was inspector of the manufacture of wood blocks for the Borough of Manhattan, New York City. During the year 1912 a large area on Broadway from 59th St. to 68th St. was paved with this material, blocks being laid on sand cushion and the joints filled with sand.

In the summer of 1913, wood-blocks were laid on Eighth Ave., New York City, between Abingdon Sq. and 59th St. The cushion here was of dry cement and sand moistened previous to laying the blocks; the joints were afterwards filled with cement grout. Longleaf yellow pine was used on both contracts; the preliminary treatment was the same in each instance, and the amount and specific gravity of the oil were practically the same (i.e., 18 lb. of oil per cu.ft., oil varying from a sp.gr. of 1.11 to 1.13 at 38° C.) Both of the streets in question carry a heavy traffic.

The peculiar thing is that upon the first pavement mentioned (Broadway) but 35 sq.yd. of repairs were required during the fall 1913 on account of bulging, while on the Eighth Ave. pavement during the fall of 1913 fully ten times this amount had to be replaced.

It is possible that excessive sprinkling—due to an existing arrangement previous to laying the new pavement—may have contributed to some extent to the trouble on the Eighth Ave. pavement, but in the main the "blow-ups" are believed by the writer to be largely due to the rigid nature of the filler employed.

Regarding the possible benefit to be derived from "dipping" new blocks previous to laying, it may be inferred from the following that this is, indeed, questionable.

In 1912, measurements of expansion and contraction, and for drying out and absorption, were simultaneously made upon test paving blocks. These tests demonstrated that blocks were expanded to the maximum extent possible during treatment; that though dried until a loss of 2% or 3% was occasioned and blocks badly checked, but a small fraction of the total amount of expansion gained during treatment (0.1 in. per lin. ft.) was lost.

Extreme conditions naturally impel many engineers to observe every possible precaution to guard against the expansion nuisance. In Norfolk, Va., the writer was told by the city engineer that the blocks are not only received *hot* from the plant of manufacture and immediately laid, but as a further precaution they are sprinkled or lightly sprayed at frequent intervals for three days before the joints are filled. Troubles from expansion are very infrequent. In Mobile, Ala., where there are 270,000 sq.yd. of this pavement, *hot* blocks are also laid. Conditions here are regarded as being exceptionally trying for the satisfactory use of wood block, owing to the excessive precipitation; however, the use of an asphaltic filler has practically obviated expansion troubles.

In conclusion, the writer would suggest that the following practices might with advantage be followed:

(1) Require that blocks be shipped within 24 hours after manufacture, and be properly protected after arrival upon street.

(2) Lay blocks upon a smooth hard mortar bed (without a cushion) as is now done in Europe. This bed under exceptional conditions might be grooved to provide underdrainage to the curb and to the storm drains.

(3) Fill joints with a nonrigid composition, preferably of the best waterproofing qualities. In many instances where drainage is very satisfactory, dry sand filler will not only be more economical, but may be advantageously used, for it is conducive to a cleaner pavement.

In the specific instance, which has called forth your remarks it may be said that the requirements as regards prompt shipment noted above have been insisted upon in every cargo manufactured. However, the extreme width of the street upon which blocks are to be laid, may be the reason why the engineer in charge may insist upon "dipping."

This, in the opinion of the writer, is not essentially necessary if the blocks are laid with fairly open joints (⅛ in.) and courses aligned and spaced by the same interval. Inasmuch as sand filler is to be used for the joints in this pavement, and as the street carries a heavy traffic, it is reasonable to suppose that the same satisfactory conditions as regards freedom from expansion troubles noted on the Broadway, New York City, pavement will obtain upon the work under construction.

R. ERNEST BEATY.

Mobile, Ala., May 18, 1914.

NOTES AND QUERIES

A. F. W. wishes to know "if there is any difference between a blank and a blind flange, and if so what the difference is."

A blind flange is a circular disk drilled for bolting to the end of a flanged pipe. Such a disk undrilled is a blank flange.

Subsidies to Motor Truck Owners in Great Britain are given by the British Government. The subsidy amounts to £110 ($530) of which £30 is paid to the owner when the machine is enrolled, and the remaining £80 is payable in six half-yearly installments. In order that the truck owner may receive this subsidy his truck must be of a make which has passed the War Department tests; and in the event of "a national emergency," the government has the right to purchase the vehicle for cash at a fixed price. Two classes of trucks are acceptable for subsidies; one of a capacity to carry 1½ gross tons net load, the other 3 gross tons. To meet the War Department specifications, the machine must have standard gear changing mechanism, must have wheels large enough to furnish ample road clearance under the machine, so that it can traverse rough country and if necessary pass through streams as deep as 18 inches. The road gear must be such that the engine can climb the steepest hill with its load unaided and a speed as high as 16 miles an hour must be obtainable when running on a smooth and level road. The gasoline consumption must not exceed 50 ton-miles per gallon. The War Department specifications for gear ratios is as follows: First speed 5 to 5.3 to 1, second speed 2.9 to 1, third speed 1.7 to 1; fourth speed direct drive. These gear ratios with the engine running at 1000 r.p.m. give road speeds of 3.2, 5.5, 9.4 and 16 miles per hour.

Some Movable Dam Crests*

By W. L. Marshall†

The designs of movable dam crests shown in the accompanying figures have been placed before the engineers of the Reclamation Service for consideration with better known devices when circumstances demand the use of hydraulic structures of this class. Types only are shown but sufficient details are given to indicate methods of operation and general construction. Patents have been allowed on all the important claims for these movable crests. These have been taken out primarily to protect the Government in the use of designs made for it, secondly, to protect the designers' private practice against fraudulent claims, and in the third place, to record definitely some ideas which may help other students of the problems involved. But the designer never advocates the use of these devices nor advertises them. Deeds have been

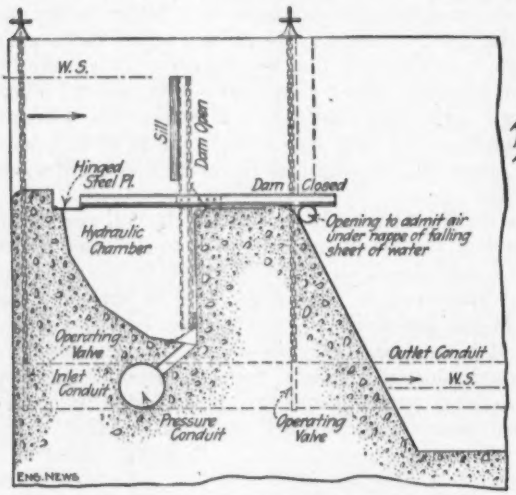


Fig. 1. Type of Dam Used on the Illinois and Mississippi Canal Feeder near Green River

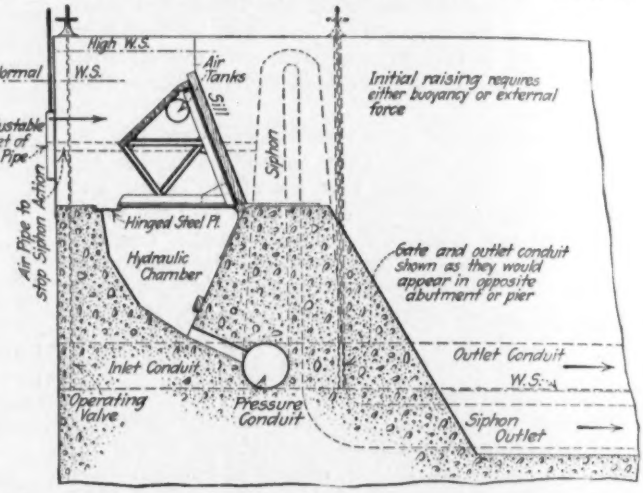


Fig. 2. Type of Movable Crest Used as Upper Gate on Locks of the Illinois and Mississippi Canal (Without drift shield and siphon.)

as upper gates on 14 locks on the Illinois and Mississippi Canal, but the lower leaves or aprons of those gates were designed of sufficient size to depress the gates automatically only when the locks are filled to within 10 in. or less of the surfaces of the upper pools. Those gates have worked successfully since 1907, although there were defects in workmanship that were corrected, and at least one uncorrected defect in design that is of no practical importance so long as the canal levels are maintained. These gates were also designed under my patents by Mr. Holth, but the completed designs were not submitted to me for correction. This type requires flotation or auxiliary power to raise it until its nose is above water, when the current may act. It may be readily modified to be applicable to spans up to 100 ft., but is peculiarly adapted for use as an upper gate to a canal lock, of 40 ft. or less span, and not exceeding 10- to 12-ft. depth.

The other two types (Figs. 3 and 4) are believed to be novel, and are now published for what they may be worth. Anyone familiar with "bear traps" will understand at a glance their working. When the movable crest is to be operated automatically by means of a siphon, all conduits leading to the hydraulic chamber should be closed except such as connect with the siphon. In this case, the inlet conduit leading to siphon and hydraulic chamber should be adjusted to admit only such flow as necessary to maintain crest at maximum height, to insure effective action at siphon. The crest may be raised or lowered by hand operation at any reservoir height. The air pipe to break siphon action should be at least $\frac{1}{4}$ of the area of siphon throat, and its entrance arranged with movable mouthpiece in order that proper adjustment of relative levels at which the dam is to act may be made. The only features worth special remark are:

(1) The care taken to so arrange the hydraulic chambers as to cause mud and sediment to be swept by the motion of the gate into or near numerous water-supply and exit pipes or "scuppers," and sufficient leakage to keep mud from accumulating. This leakage may be reduced to any extent by well proven means.

(2) The arrangement of piping for the above purposes, and to secure uniform distribution of water pres-

or will be executed so that the Government may use the designs free on all public works.

The types shown are not all novel; the two types at the top of the drawing are covered in whole or in part by a patent granted in 1898. The straight or plane gate type (Fig. 1), modified to suit local conditions, has been in use since 1907 on the feeder of the Illinois and Mississippi Canal near the aqueduct crossing Green River.‡ It is placed horizontally in the bottom of the feeder as an emergency stop gate, to rise and retain the canal level in case of a break in the banks. The particular gate was designed by Christopher Holth, Mechanical Engineer, and constructed by L. L. Wheeler, Assistant Engineer. The canal bank broke in 1910 and the gate automatically rose and closed the feeder, retaining the level in the feeder canal. It then repaid its cost.

The second type (Fig. 2), but without the wooden drift shield and siphon, has also been in use, since 1907,

*In part from "Professional Memoirs of the Corps of Engineers, U. S. Army," May, 1914.

†Brigadier General, Corps of Engineers, U. S. Army (retired); former Chief of Engineers, U. S. Army; Consulting Engineer to the Secretary of the Interior, Washington, D. C.

‡See "The Emergency Gates of the Illinois and Mississippi Canal," by Maj. P. S. Riché, Corps of Engineers; "Professional Memoirs," 1910, p. 327.

sures along entire length of gate by making the main conduits of much greater capacity than that of all distributing pipes or conduits combined.

(3) The siphon for automatic control of the gates during floods, in addition to hand control. These siphons "bleed" the supply mains before water in them may reach under pressure the small distributing pipes leading into hydraulic chambers. They have discharge capacities

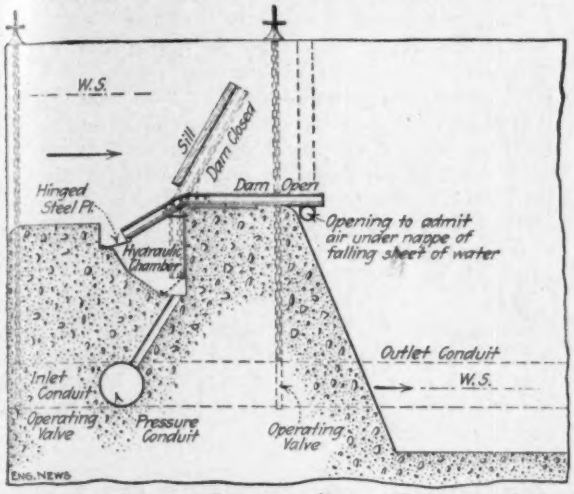


FIG. 3. PROPOSED RISING CREST

from one side to the other of the axis of rotation, and the gate rises.

The type with siphon control falling downstream admits trussing or bracing, etc., so that it is possible to make it very light, and at the same time strong and stiff against warping and of any reasonable length. It may be advantageously used up to 10- to 12-ft. lift on high spillways and dams. The width of that part below the axis of rotation in any of these movable crests should be not less than five-eighths the width of upper section, exclusive of width of flap leaf; the relative proportions of parts of gates should be computed to meet the special conditions in each case.

Steel plates are hinged to edges of lower sections and move along inclined planes in order that there shall be elasticity in the system even under considerable wear at axis and inaccurate work. The gates will not be subject to wedging and obstruction by gravel, chips, etc., and these narrow leaves remove most of the objections that have been made to drum weirs, etc., the leaves of which must be nearly in contact with the curved surfaces of hydraulic chambers, and are often wedged. These plates may be in sections of desirable lengths, the joints between lengths may be stopped against leakage by strips of pure-rubber packing, allowing any section to rise or descend enough to pass over any chance pebble or chip without serious leakage, or straining the gate, and the plates as a whole to adjust themselves to wear or inaccurate work-

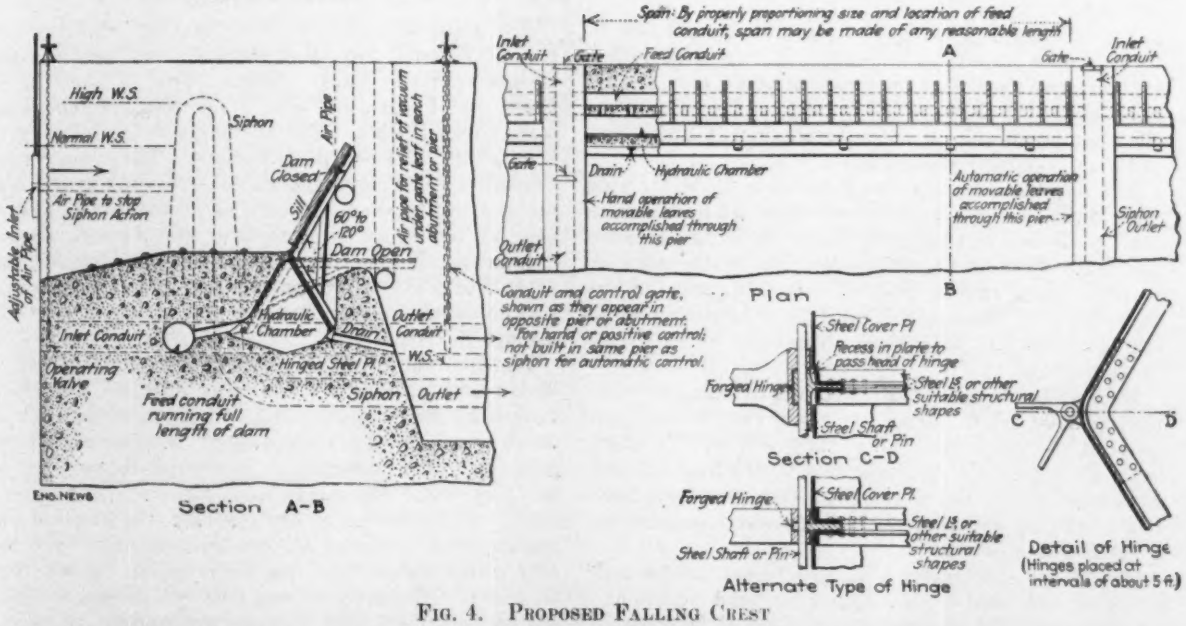


FIG. 4. PROPOSED FALLING CREST

nearly equal to but less than the main conduits, so that (if the hand-operating devices be closed) whenever during a flood the water level above a dam reaches the level of the siphon throat or top, the siphon at once "bleeds" the supply main. Then the preponderance of water pressure is at once changed from one side to the other of the axis of rotation of the gate, and it will fall and remain flat until the level in the reservoir falls below the air inlet to siphon. Thereupon the siphon action is broken, the full pressure is again exerted throughout the surface of the gate, the preponderance of pressure is again shifted

manship, location of axis or in forming the plane surfaces of the hydraulic chamber.

(4) The air passages to remove vacuums that form under the gate, due rapid flow of water over it when down, are not novel, even in the particular disposition of them. Vacuums more or less complete under overfalls increase materially the pressures on the upstream faces of gates and dams; cause tremblings and vibrations in dams, and in old bear-trap forms sometimes determine whether they can be worked at all in certain positions or phases of their motion.

The question of prevention of partial vacuums, then, is of some importance in all dams, whether movable or fixed, and especially so in bear-traps, where little or no attention has been given the subject.

Regulation of Reservoir Level with Hand- and Automatic-Spillway Crests, or Sluiceway Gates

Some criticisms of automatic movable sluice gates have been based upon the opinion that their movements are so rapid that there would be thrown into the stream below the reservoir large amounts of water *en masse*, thus creating waves of such magnitude that damage to life, or property might result. This objection is well founded, but that it may be easily removed is evident when it is considered that the movable crests, or spillway gates proposed are in fact hydraulic engines, capable, if properly constructed, of as smooth, gradual and certain movement and control (and by similar methods) as any other hydraulic press or engine.

It is necessary for this purpose, in a series of sluiceways controlled by automatic gates, to provide one and only one sluiceway of the series, with a hydraulic gate to be operated carefully by hand, in order to make the increase in discharge as gradual as it would be over a fixed or movable horizontal weir of suitable length, by filling in by gradual increase in discharge the differences in total discharge caused by the sudden periodic gate movements.

For instance, suppose there is an available site 350 ft. in length for a spillway to be used in connection with a large reservoir, and that the maximum flood to be wasted is about 25,000 cu.ft. per sec., and it is desired to store all water practicable in the reservoir, with a fluctuation in its water level of about 2 ft.

The effective depth of the sluiceways, if 50 ft. wide each, must be 9 ft. at maximum flood level, and there must be six such sluiceways of that width to discharge the maximum flood of 25,000 sec.-ft. The sluice gates or movable crests may be made of 7-ft. lift each, and the water levels in the reservoir must be so controlled as to rise not more than 2 ft. above their crest level when in raised position.

Each 50-ft. sluiceway 7 ft. deep will discharge approximately 3000 sec.-ft. When the water rises to the limit assumed, the gates being down, there will be 9 ft. depth in the sluices and the discharge of each will then approximate 4500 sec.-ft. The discharges may be less than above given, but they are assumed for demonstration; accuracy is not now in question.

One of the sluice-gates is to be of most careful construction, and fitted in all its parts for hand control and operation, and five of them are supposed to be operated automatically by siphon, all gates being of a type falling downstream from the reservoir. These latter have the siphon throats and their air-entrance breaks adjusted in level so that the gates will fall in succession, upon increments of say about 3 in. in reservoir levels, beginning with the first gate falling when that level reaches 7 in. above the crest when raised, and the last or sixth gate falling when the level of the reservoir is about 3 in. below the maximum safe limit named above. Now, when the water level in the reservoir rises until it is nearing 7 in. above the crests of the gates—at which level the first gate is arranged to fall—the operator would begin to lower the hand-operated gate at a rate that [illegible] reserves the level of the reservoir water until that gat[illegible] fully depressed.

Whenever the first automatic gate goes down, [illegible] hand-operated gate should at once be raised, and [illegible] same gradual movement of the hand-operated gate b[illegible] esumed between the falling of the first and second, etc., [illegible]d succeeding automatic gates, if such care be necessary. It is, then, practicable to make the discharge from a reservoir by the use of these gates, or indeed of any of the "bear-trap" family, as gradual and regular as by any other device, even if that device be a fixed weir. But the controlled sluiceways have the material advantage over the fixed weir of allowing the storage of 7 ft. (in this case) depth of water over the entire surface of the reservoir, which cannot be done by a fixed weir of same length of crest with as little waste and as little fluctuation in water level in the reservoir. The sluices, moreover, serve admirably for drift chutes.

In some very large reservoirs now in existence, or under construction, this additional storage of 7 ft. in the reservoir might run to a hundred thousand acre-feet or even much more, a matter of very great importance in our arid region, where water is so precious for irrigation and domestic use.

National Conference on City Planning

The sixth annual Conference on City Planning was held at Toronto, Ont., May 25 to 27, with members and delegates present from various parts of the United States and Canada and with a few speakers and guests from Great Britain. The sessions and exhibition were held at the University of Toronto. The Conservation Commission of Canada entertained the members at a dinner and lunches were provided on successive conference days by the Province of Ontario, the Toronto Harbor Commission and the City of Toronto. One afternoon was devoted to a boat trip to see the improvements being carried on by the Harbor Board and to an automobile trip through the city.

The program was well arranged and interesting both in design and fulfilment. Its major features were local waterfront development and city transportation, each of which was assigned a whole session. Another session was given up to the protection of residential districts, and to the playground and recreational facilities in American cities. The financing of city planning, the proposed Canadian town planning act and garden cities were the only remaining set topics on the program. It will thus be seen that the program was relatively simple throughout and not overloaded with a great number or variety of subjects at any one session.

Before taking up such parts of the proceedings of the Conference as we have chosen for mention in more detail it may be stated that when these conferences were begun there was some hesitation about adding to the large number of societies already existing, so the Conference was organized and has been carried on from year to year with little other machinery than an executive committee. The officers of this committee are: Chairman, Frederick Law Olmsted, Brookline, Mass.; Vice-Chairman, Nelson P. Lewis, New York City; Secretary, Flavel Shurtleff, 19 Congress St., Boston, Mass.

Waterfront Development

Robert S. Gourlay, of the Toronto Harbor Commission, gave an address on the "Basic Principles of Waterfront Development," as illustrated by the Plans of the Toronto Harbor Commission. Summarized, his "basic principles" were that the waterfront is a heritage of great value to the citizens; that it should be municipally owned and developed for the greatest benefit of all the citizens of this and future generations; that if not profit making it should at least be self-supporting; that there should be water depth sufficient for the greatest craft; that there should be ample freight-handling, warehouse and manufacturing facilities and also a large central wholesale and retail food market, as well as coördination of steamship, steam railway and radial (electric) railway lines; that marsh land should be reclaimed; and that in land and water reclamation there should be provided only good land and deep water. In addition to this already ambitious program there should be provided recreation and amusement facilities, including parks, driveways, bridleways, walks, safe channels for small craft, bathing beaches and locations for summer homes.

All these things are actually or tentatively included in the Toronto harbor and waterfront improvements now in hand (see Engineering News, May 29, 1913, p. 1116, for general description of the project). The commission hopes to acquire nearly all of the ten miles of water front; to provide 31½ miles of docks and perhaps add 2½ miles more; to afford connections with the three transcontinental railways; to provide two 350-acre parks; besides various other things. The total estimated cost of the project is $25,000,000, or $17,000,000, omitting nearby city docks projected for some time in the future. Part of this expense will be met by the Federal government. Already about $10,000,000 of contracts have been let by the city and the government.

A lengthy discussion followed this address, dealing largely with local issues, but bringing out the fact that at present water tonnage is slight at Toronto and has not increased much of late. The discussion also showed strong feeling on the part of many that a project which, like this one, is expected to enhance values of adjacent land should be paid for in part by assessments for benefits. Others suggested excess condemnation of land, with resale and profit-taking by the city.

Municipal Financing and City Planning

This subject was introduced by Andrew W. Crawford, of Philadelphia. He urged that the life of city bonds should not outrun the life of the improvement they are to pay for and said there is a tendency now to make bonds run 50 years. He suggested that amortization charges should be made heavy at first and light afterwards for short-lived improvements and the reverse for long-lived. Thus, the sinking-fund contributions for pavements might be made almost wholly in 15 years while those for land might be light for a much longer period, then heavier at the end. By this means, those who got the chief benefit would pay for it.

In the discussion of this paper one speaker urged that serial bonds be used instead of long-term bonds, and said that this is now mandatory in Massachusetts. E. P. Goodrich, of New York City, said that long-term bonds mean paying for the improvement several times over. A city of 300,000 people has recently decided to spend $1,600,000 a year for improvements, paid from the tax levy. On this plan it can get $50,000,000 of improvements in 50 years. On the long-term bond plan it could make $1,000,000-a-year improvements for 16 years only.

A serious aspect of Canadian municipal indebtedness was brought out by G. Trafford Hewitt, of London, a Garden City enthusiast who at the same time is engaged in the sale of municipal bonds or debentures. He said that within the past two years London has been asking whether Canadian cities are not overborrowing. He thought that Canada should have a Federal Local Government Board (like Great Britain) to pass upon all municipal loans. George Langley, Minister for Municipal Affairs for Saskatchewan, said that the legislature of his province, at its last session, created a Local Government Board of three members, who serve for ten years each and have absolute power of examination and veto of all municipal loans in the province. The board consists of a lawyer, an engineer and a business man. Thos. Adams, of London, England, thought that the lessening British confidence in municipal loans was not so much due to overborrowing as to a belief that Canadian real-estate values are speculative.

John Nolen, of Cambridge, and Frederick C. Howe, of New York, speaking of cities generally, thought that they are too unwilling to incur indebtedness for municipal improvements. Mr. Howe suggested the more general adoption of methods which will place the cost of municipal improvements on real estate whose value is increased thereby; also the issuance of municipal bonds secured only by the revenue from the industries which the bonds are issued to build [as water-works or electric lights].

City Planning Progress

A long evening was devoted to recent progress in city planning, centering around a tentative Town Planning Act prepared by a committee of the Canadian Commission on Conservation (Ottawa, Ont.). As explained by a member of the committee, any such legislation can be suggested, only, by the Dominion Government. Accordingly, this bill has been drawn and submitted for the widest possible criticism. After it has been improved, it will be submitted to the nine provincial legislatures for possible enactment, with such modifications to meet varying provincial conditions as they may deem fit.

Briefly, the bill provides for provincial town planning boards, under provincial departments of municipal affairs. These boards would consist of a "town planning comptroller, who shall be a permanent paid executive officer, skilled in town planning and chairman of the board, and responsible to the minister" of municipal affairs, and of a number of members of the provincial government serving *ex-officio*. The bill authorizes every municipal authority to create a local housing and town-planning board, consisting of the mayor, town engineer, medical health officer and not less than two ratepayers, preferably an architect and a financier. Municipal authorities adopting the act would also appoint a housing and town-planning commissioner, "skilled in town planning," who would be executive officer of the planning board and who would not be removable from office nor subject to reduction of salary without approval of the central planning board. The central authority, on its own motion

or on petition of ten or more municipalities, would have power to appoint a local planning board.

Any local planning board would be a corporate body, with power to acquire, lease or sell property, and to prepare and adopt a town-planning scheme, each of these two steps to be subject to the approval of the central planning board. No funds to carry out a town-planning scheme could be raised without the approval of the local city or town council. The principles of ordinary and of excess condemnation are embodied in the bill.

Thomas Adams, Town Planning Inspector of the Local Government Board, London, England, was asked to criticize the bill but was unwilling to say more than give the general scheme approval, pending knowledge of local governing conditions. He stated that the proposed bill was in many respects like the British Town Planning Act. He proceeded to talk about recent British town planning and showed many interesting lantern slides. He distinguished between city planning under German and Swedish laws—which is confined to the control of the lines of streets and open places, skylines and monuments, without touching the homes of the people and which even force high buildings and overcrowding because of the expense of wide streets—and British town planning, which embraces every aspect of municipal life, safeguarding health, providing homes and proper factories for the people and insuring the amenities.

Mr. Adams stated that 152 of the authorities surrounding the County of London have chosen two representatives each to meet with a representative of the Local Government Board and the Board of Trade to consider town-planning problems common to the 152 authorities.

In a lengthy and spirited general discussion of the proposed town-planning act for the Canadian provinces some fear was expressed as to lack of coördination between local planning commissions and local councils and also as to the willingness of the cities of some of the provinces, especially the far western, to submit to central control. On the latter point, Dr. Peter H. Bryce stated that the same general objection was raised when the Ontario Provincial Board of Health was created, and Dr. Chas. Hodgetts remarked that city planning is largely a matter of public health. It appeared from the discussion that several of the provinces have already adopted or taken steps to adopt some measures of town planning and that on the whole there was a strong feeling in the audience of approval of the general terms and spirit of the Conservation Commission bill.

The discussion just outlined lasted until about 11 p.m., leaving scant time for Flavel Shurtleff, Secretary of the Conference, to present his annual review of American progress in city planning, which has come to be a valuable feature of these conferences. The greater part of this report will be given in a later issue. Suffice it to say here and now that many city-planning commissions were established in 1913 and some city-planning projects carried forward toward the completion of actual construction.

City Transportation

Papers on the "Utility of the Motor Bus," by John A. McCollum, Assistant Engineer, Board of Estimate and Apportionment, New York City, and on "Future Rapid Transit: Subway, Elevated or Open Cut," by J. V. Davies, Consulting Engineer, Brooklyn Rapid Transit Co., were presented in abstract by their authors, and gave rise to lengthy and interesting discussion.

Mr. McCollom sketched the rapid growth of the motor bus in London, spoke of its somewhat extensive use in Paris and less wide use in New York City—which last will probably soon be increased by the granting of franchises for new routes under a legislative act of 1913. Great advantages of the motor bus are flexibility of route and low first cost. A disadvantage is high operating cost. Motor busses should be confined to routes which will supplement street railways. They may be useful in suburban districts. Their probable effect on street pavements should be considered. Until more experience has been had, motor-bus franchises should be for but short terms.

By way of discussion on this paper, George McAneny, President Board of Alderman, New York City, expressed the belief that we are just at the dawn of the motor bus, and that it will be a useful supplement to rapid transit. Duncan MacDonald, of Montreal, said that the success of the motor bus in London dated from municipal regulation of the cars and service. He also remarked that the London motor busses which serve the congested districts weekdays can be turned countrywards on Sundays. E. P. Goodrich, Consulting Engineer, New York City, stated that the cost of operating motor busses is largely influenced by the character of the pavements. In London it has been found that these vehicles have damaged foundations to pavements and have broken conduits. He was of the opinion that motor busses should pay for the use of the streets. Thos. Adams, of London, England, cited a London street with heavy foundation and granite pavement which was regarded three times within a short period to make good damages by motor busses. Mr. Adams also urged that for suburban motor-bus service better roads would have to be provided than are generally found in North America—better as regards stability and dust.

Mr. Davies' paper on rapid transit contained some interesting comparisons of the unit cost of suburban and city trolley lines on the surface, underground trolleys, elevated railways and subways under various conditions. Mr. Davies urged that city planners should first of all study transportation problems, as all city growth is dependent on transportation facilities.

In the discussion of this paper, Thos. Adams said that instead of city planning being based on transportation the latter should be based on city planning. George McAneny remarked that too often our cities have allowed railway officials to take the place of the city government in laying out transportation lines. In New York City, under the new subway plans, lateral city growth is to be forced by regulating the height of buildings. E. M. Bassett, a former member of the Public Service Commission of New York City, said the high cost of providing rapid transit for New York is due largely to lack of foresight in laying out a street system. Other cities will be in the same fix if they do not lay open broad streets.

Business Session

The one brief business session was confined chiefly to a reëlection of the executive committee, with slight changes and to the election of Thos. Adams and two others as honorary members. The executive committee elects its own chairman and secretary.

A Lumber-Yard Fire Which Wrecked Two Steel Viaducts, Cleveland, Ohio

By C. E. Drayer*

During the night of May 25-26, a fire in the lumber district of Cleveland very seriously damaged two steel viaducts and for a time threatened to spread out over the city in a general conflagration. The behavior of the steelwork under fire is of exceptional interest to engineers.

At 8:50 on the evening of May 25, the first fire alarm was turned in from the wholesale lumber district on the flats along the easterly side of the Cuyahoga River. Other alarms followed in rapid succession until practically the entire fire-fighting force of the city was called out to combat probably the greatest conflagration in the city's history. An area of 15 acres thickly piled with some fifteen million feet of sawed lumber was swept over, and a portion of Central Viaduct belonging to the city, and of the

*1801 E. 93rd St., Cleveland, Ohio.

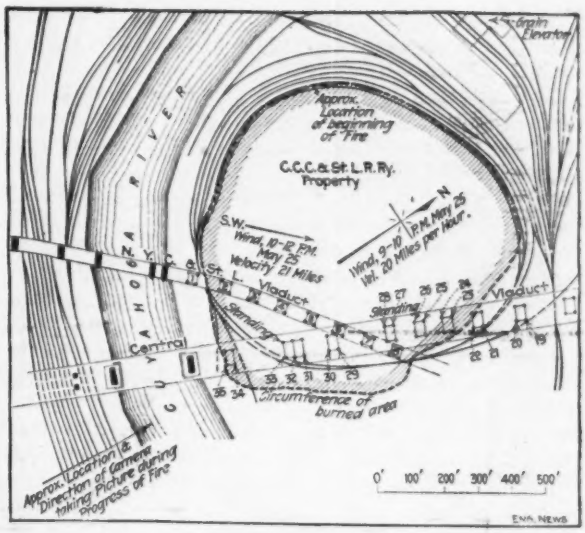


Fig. 1. Extent of Conflagration of May 25-26, Cleveland, Ohio

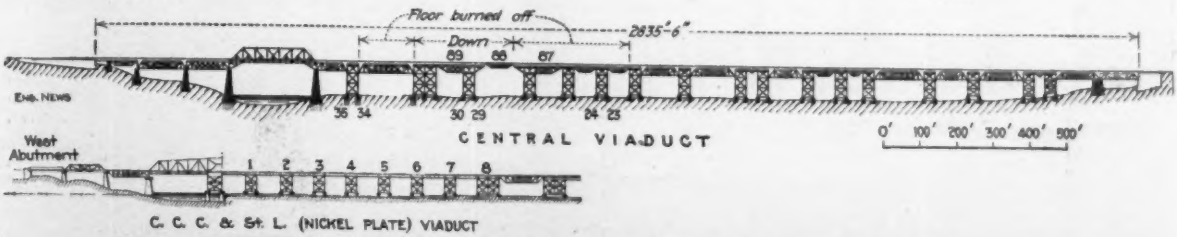


Fig. 2. Outlines of the Central Viaduct and Nickel Plate Railway Viaducts

Fig. 3. View of Fire in Night of May 25, Cleveland, Ohio
(Cuyahoga River in foreground; Central Viaduct in front and railway viaduct in rear of view.)

Nickel Plate railroad viaduct were wrecked. The total direct loss is estimated at the present time to be about a million dollars. No lives were lost.

The fire began adjacent to the Big Four tracks on the northwesterly side of the lumber district near Elevator A of the Cleveland Grain Co., where cars belonging to Ringling Bros. circus were stored during the show's two-days' stay in the city (see Fig. 1). Chief Wyler, of the Cleveland fire department, is of the opinion that the fire was started by employees of the circus with these cars or from a lighted match carelessly thrown into combustible material by someone passing along the tracks to the show tents pitched not far distant on Scranton Road.

Reports of the U. S. Weather Bureau station from its observatory on top of the Society for Savings building show between the hours of 9 and 10 on the evening of May 25 a south wind blowing with a velocity of 20 miles per hour; from 10 p.m. to 12 a.m., the wind was in the southwest, blowing at the rate of 21 miles; for the balance of the night until 6 a.m., the wind was from the south with a velocity of about 20 miles per hour. The fire must therefore have traveled about 45° into the wind. Fire Chief Wyler adds the weight of his experience to the statement that a fire under such conditions as existed in the Cleveland lumber flats will travel faster and burn more fiercely against the wind than with it. He says the suction upward was so great as to pick up loose boards 2x12 in.x14 ft. as if they were cards from the tops of lumber piles fifty feet and more from the flames.

The fire was circumscribed and under control at about 1:30 a.m. of May 26, but it continued to burn fiercely until about 3 a.m. when it had about burned itself out.

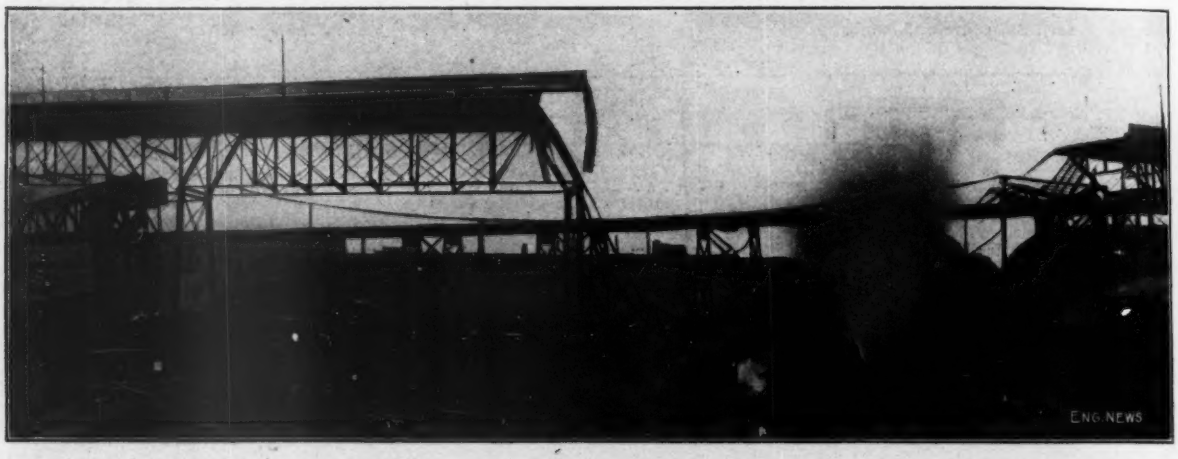


FIG. 4. VIEW BENEATH VIADUCTS AFTER FIRE
(Central viaduct in foreground; Nickel Plate viaduct in background, roller lift span at left, then Towers 1, 2, 3, and 4.)

CENTRAL VIADUCT

Of this structure, about 270 ft. is a tangled mass lying on the ground and across the Nickel Plate Viaduct. About 320 ft. of creosoted roadway on the northerly side of the railroad, and 150 ft. on the southerly side is burned away. The loss is estimated by Bridge Engineer Frederick D. Richards of the city to be $125,000, and the time necessary to restore the damaged part of the viaduct about three months.

Central Viaduct, built in 1887-88 by the King Iron Bridge and Manufacturing Co., now the King Bridge Co., is an iron bridge 2835 ft. 6 in. from face to face of backwalls, and is made up of a series of pin-connected simple Pratt deck trusses on iron towers, except the river span which is a through steel truss. Two years ago the swing span over the river was replaced by the present fixed span clearing mean low water 93 ft. The roadway of the wrecked portion was about 90 ft. above the ground surface and about 32 ft. above the top of rail of the railroad bridge.

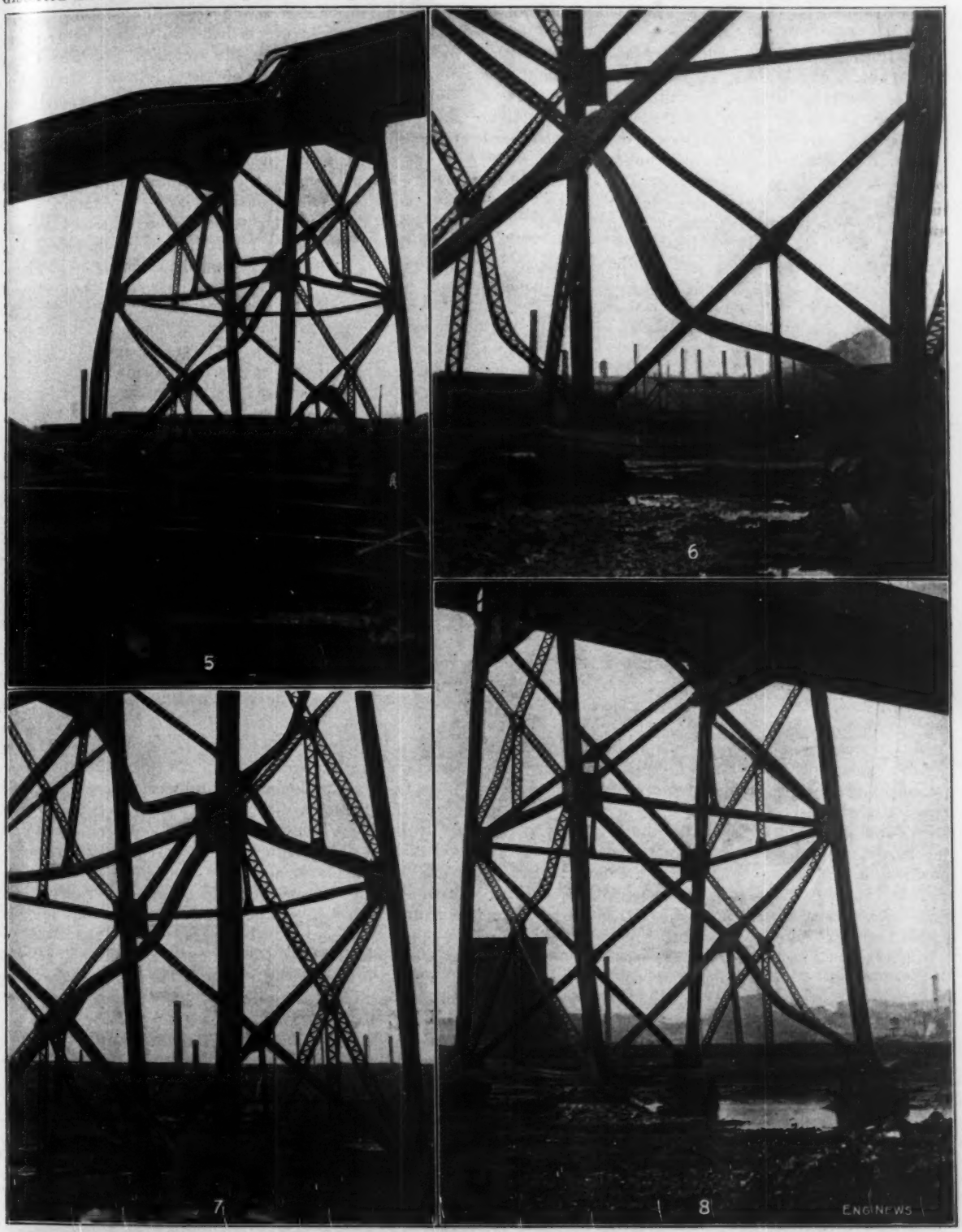
From the best information now obtainable, the viaduct fell between 12 and 1 a.m., May 26. Two theories to explain initial failure are advanced. One is that the expansion on either side of Truss 88 (Fig. 2) supported on the cantilever ends of Trusses 87 and 89 caused the link truss (88) to rise and separate the half-hole pin-connection at one end. The other end of the truss would then drop and start the collapse. The other and more plausible theory is that the sway rods in the towers were first pulled loose, then the tower posts, intensely heated, particularly in Tower 30-29, crumpled. An eye witness is reported to have said that the fall was not sudden but a gradual subsidence.

The wearing surface of the roadway on the viaduct is 4-in. creosoted wood blocks on 4-in. creosoted tongue-and-groove plank lying on the iron floor stringers. Between the blocks and planks is a ⅛-in. felt layer. The 8x14-in. curbs are also creosoted, but the 2-in. sidewalk plank are untreated.

The inflammability of the creosoted roadway and the heat developed by it contributed largely to the damage. Under the most of the viaduct where the floor was burned off, the fire on the ground was of too low intensity to do much damage to either the towers or the trusses, but some top chords of the trusses are buckled, twenty floor-beams on the northerly side of the railroad and one on the southerly side will have to be renewed, while everything above the floor-beams is so badly warped and twisted as to require complete renewal. The damage to the floor-beams was caused in the main by the street-car rails and stringers carrying the rails moving toward the gap when the collapse occurred and pulling the centers of the hot beams out of line.

Nickel Plate Viaduct

The Nickel Plate Viaduct suffered seriously over about 500 ft. of its length by having the steel members badly distorted and the foundation piers disintegrated by the heat. E. E. Hart, Chief Engineer of the N. Y. C. & St. L. R.R., estimates that $25,000 will cover damage to the railroad viaduct. He expects traffic to be restored over the west-bound track in about two weeks after the fire. Tim-



Figs. 5-9. Views of the Nickel Plate Viaduct after the Fire, Showing Distortion of Members
(Fig. 5, Tower 5; Fig. 6, Tower 4, note sandstone pedestals; Fig. 7, Tower 5, note concrete pedestals; Fig. 8, Tower 3.)

ber is being hauled by team from an adjacent lumber yard as needed to frame bents, one under each end of the girders, with an extra bent in Tower 5 where the 30-ft. girders are badly buckled. Permanent repairs, already begun by the King Bridge Co., are to be completed in 60 days.

The railroad viaduct, built in 1905-06 by the King Bridge Co., is double track, about 3000 ft. long, and consists of five truss bridges, one through plate-girder, a roller lift across the river, and the balance deck plate-girders. That part swept by the fire is the last mentioned type, and, except the one between Towers 1 and 2 which is a 66-ft. span, the girders are alternately 30 ft. and 60 ft. Where the structure was subjected to the fire, alignment is partly a 3° curve convex to the northwest. Ties are 8x11 in.x10 ft., oak and untreated.

No part of the railroad viaduct fell, but stands an interesting illustration of the effect of fire. In all, eight towers and spans were more or less affected, from the loss of paint and ties only on that portion at the edges of the fire to the distortion of every member in Tower 5 where the 30-ft. girders are buckled far out of line. Besides the distortion which is apparent in the photographs, webs of a good many girders are buckled laterally, in some instances about 2 in., and rivets were loosened in top and bottom angles on the girders. The southerly side of the viaduct all along suffered more severely than the northerly side, although the approach of the fire was from the northwest. Several observers claim there was a change in local air currents, and that after the fire was burning on the south side of the bridge, a reversal of draft kept the heat against this side for a longer time than it was against the north side. All pictures are taken on the southerly side of the bridge.

In Tower 3 (Fig. 8), girders at the expansion end over the west posts are parted about 6 in.. A similar gap, due to contraction after the fire, occurred in Towers 4, 5 and 6. In the picture of Tower 3, the sandstone piers under the southerly posts are shown badly disintegrated. Some idea of the intensity of the heat may be gathered from the fused ashes to be seen in the foreground of the picture. Caps of the westerly piers were moved slightly east.

In Tower 4 (Fig. 6), the northwesterly stone pier cap was moved east about 3 in., while the southeast cap moved west, indicating twisting of the tower. Severe spalling of sandstone pier is to be seen in the lower right-hand corner of the picture. Northerly members of this tower are less distorted than southerly.

In Tower 5 (Figs. 5, 7), was the most intense application of heat. In Fig. 7, where the pedestals are shown, a fair comparison may be made of the relative ability of concrete and sandstone to withstand heat. The shattered sandstone between the pedestals and under the strut is the old pier caps which were whole and in good condition before the fire. The concrete is cracked but not so badly damaged but that it would carry its load with trains operating under slow orders. In the other view (Fig. 5), the girders are bent in the direction of the curvature of the track, outside and to the north.

General Observations

The land where the fire occurred is the property of the C., C., C. & St. L. Ry. over which the city and the railroad have easements only for their viaducts. Since the fire, city officials have raised the question whether under police powers the city can restrict the selling of lumber so as to remove the danger from fire in the future.

Speculation is interesting as to the probable results had the fire spread over a little wider area either north or south. According to the statements of Fire Chief Wyler, had Elevator A of the Cleveland Grain Co., which caught fire several times, burned, a general conflagration similar to a Baltimore or Chicago fire would have followed. Had the fire not been checked about where it was on the south, it is altogether probable that the river span of Central Viaduct would have gone down causing a long and expensive delay to navigation.

During the day after the fire, the railroad company had started temporary repairs to its viaduct and had made arrangements with the bridge company to go ahead with permanent repairs. Three days later the forces of the bridge company were at work, first cutting away with oxyacetylene the portion of the city viaduct fallen across the railroad. There are no powers delegated to city officers by which they may proceed with like expedition in time of similar disaster. The city received bids for restoration of its viaduct on June 2. Money is provided by emergency bonds voted by the City Council.

The writer is indebted to E. E. Hart, Chief Engineer of the Nickel Plate, to F. D. Richards, City Bridge Engineer, of the City of Cleveland, and to G. E. Randall, Assistant Bridge Engineer of the city for their assistance in gathering information pertaining to the fire and its effects.

The Chinese Flood Prevention Engineering Commission

We noted briefly in our issue of May 28, the appointment of a commission of American engineers, which is to take charge of flood-prevention work in China, in regions which have suffered from floods and resultant famines for more than 2500 years. During these thousands of years, while millions upon millions in provisions and necessities of life have been contributed directly and indirectly by the Chinese Government and people, and in recent years by foreign nations, never has a single attempt been made to avoid the constantly recurring catastrophes by the aid of engineering construction. It remained for an American engineer, Charles D. Jameson, to point out the preliminary measures, and now the final steps are about to be decided upon and the actual construction work begun by a commission of three American engineers, whose portraits and biographies we present herewith. In Engineering News, Sept. 25, 1913, Mr. Jameson described in some detail the work which the Commission must undertake.

Lieut.-Col. William L. Sibert, U. S. A.

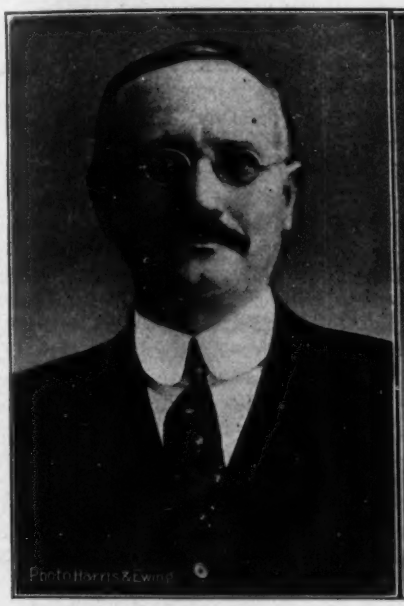
The President of the United States was asked by the American Red Cross Association, which is acting with the Chinese Government in raising funds to carry out the work, to appoint an officer of the Corps of Engineers, U. S. A., to act as chairman of the commission. The officer selected was Lieut.-Col. William L. Sibert, who already has a world-wide reputation as the Division Engineer of the Atlantic division of the Panama Canal,

which included thhe construction of the famous Gatun locks and dam.

William Luther Sibert was born at Gadsden, Ala., Oct. 12, 1860. He attended the University of Alabama for two years and then entered the United States Military Academy at West Point, where he graduated in 1884, a classmate of the late David DuBose Gaillard, Gen. H. M. Chittenden, of Seattle, Wash., and Maj. Cassius E. Gillette, of Philadelphia, Penn.

After three years' service with the battalion of engineers at Willett's Point, N. Y., he was promoted to be First-Lieutenant and made Assistant to Major Lockwood and Recorder of the Board of Engineer Officers on the proposed Ohio River bridge at Cincinnati, Ohio. From 1888 to 1892, Lieut. Sibert was in charge of local improvements on the Green and Barren Rivers at Bowling Green, Ky. From there he went to Detroit, Mich., and later to Little Rock, Ark., where he had charge of a Mississippi River district. He was commissioned Captain in 1896.

After a year with the engineer battalion at Willet's Point, N. Y., Capt. Sibert saw active service, in 1899-1900, in the Philippine Islands, where he had command of Company B, Second Division, Eighth Army Corps. Returning to this country he was in charge of the Louisville, Ky., and Pittsburgh, Penn., districts, respectively, of the Engineer Department. Early in 1907, he was appointed a member of the Isthmian Canal Commission and Division Engineer of the Atlantic division of the Panama Canal.



LIEUT.-COL. WILLIAM L. SIBERT, CORPS OF ENGINEERS, U. S. A.

ARTHUR P. DAVIS, CHIEF ENGINEER, U. S. RECLAMATION SERVICE

DANIEL W. MEAD, PROFESSOR OF HYDRAULIC AND SANITARY ENGINEERING, UNIVERSITY OF WISCONSIN

ARTHUR P. DAVIS

Arthur Powell Davis, Chief Engineer of the United States Reclamation Service, was born Feb. 9, 1861, at Decatur, Ill. He was educated at the State Normal School at Emporia, Kan., and in 1882 joined the staff of the United States Geological Survey, studying at the same time at Columbian (now George Washington) University, where he received an engineering degree in 1888. The same year he entered the irrigation survey division of the Geological Survey. In 1894, he was transferred to the hydrographic division on stream measurements.

When the Nicaragua Canal Commission made its surveys on the Isthmus in 1897, Mr. Davis was given charge of the hydrographic work. Subsequently, in 1899 and 1900, he had charge of the hydrographic work on both the Panama and the Nicaragua routes; in connection with this work he was sent to Paris to examine the Panama Canal records.

Upon the organization of the Reclamation Service in 1902, Mr. Davis was appointed Assistant Chief Engineer, under Frederick H. Newell, Chief Engineer. In 1907, Mr. Newell was made Director and Mr. Davis became Chief Engineer. In 1909, Mr. Davis was appointed by President Roosevelt a member of the board of engineers to accompany President-Elect Taft to the Isthmus of Panama to decide upon the feasibility and safety of the Gatun Dam, and upon the type of canal, lock or sea-level, to be built. Later in the same year he served as a member of board of consulting engineers on Porto Rican irrigation work.

Mr. Davis is already familiar with the East. In 1911, he went to Turkestan for the Russian Government to investigate and report upon irrigation projects. He has also served as Consulting Engineer on dams and irrigation projects in this country and Alaska. Mr. Davis has been granted leave of absence for five months to undertake his new work.

DANIEL W. MEAD

Daniel Webster Mead was born at Fulton, N. Y., Mar. 6, 1862. At 17 years of age he entered a machine shop

in Rockford, Ill., where he worked for over two years. In 1881, he entered Cornell University, where he graduated in civil engineering in 1884.

Like Mr. Davis, his early experience was with the United States Geological Survey, where, however, he remained but a short time, resigning in 1885 to become City Engineer of Rockford, Ill. After a term as City Engineer he took up contracting work as Chief Engineer and General Manager of the Rockford Construction Co., contractors for municipal work throughout the Middle West. During this period, Prof. Mead designed and built many sewer and water-works systems.

Since 1900, Prof. Mead has been in consulting practice, mostly on hydraulic work, including many large municipal water-works, irrigation and drainage projects and hydro-electric developments. In 1904, he was appointed Professor of hydraulic and sanitary engineering at the University of Wisconsin, which position he now holds. At the same time he has continued his consulting practice and has acted as Chief Engineer of the Southern Wisconsin Power Co. the Northern Hydro-Electric Power Co., the Wisconsin River Power Co. and the Peninsular Power Co.

Prof. Mead is well known to educators and students by his textbooks, "Water Power Engineering," "Notes on Hydrology," "Hydraulic Machinery," and others.

In regard to the engineering work to be done by the commission, Mr. Jameson, in his preliminary report published in ENGINEERING NEWS, Sept. 25, 1913, said that although surveys had already been made by Chinese survey students, which were of some value, there was much work to be done requiring the services of several well organized survey parties for a long time. One of the most important branches of the work to be organized will be a weather bureau. As there are few Chinese engineers experienced in hydrographic work it is probable that many American assistants will be ultimately required.

The three commissioners propose to sail from Vancouver, B. C., for China direct on June 11.

A Disastrous Explosion in a Sewer Screening Station

At the Chelsea St. pumping station of the Metropolitan sewerage system in East Boston, Mass., a fatal explosion occurred on June 1, at 10:30 a.m., in the screen house, adjoining the pumping station. The screen house is a one-story structure about 22x26 ft., which joins the pumping station at one corner only. The explosion caused the death of three men and the serious injury of several others.

The screen house was completely wrecked, the brick walls being blown outward and the reinforced-concrete and tile roof was blown to pieces. The main pumping station adjoining was seriously damaged by the shock, one end wall being demolished, while three of the four pumps were put out of commission, one being entirely wrecked.

The men working in the screen pit were burned, but not seriously injured, and they were removed by the firemen who responded quickly to the alarm. One of the men killed appeared to have been at the center of the explosion, practically every bone in his body being broken. The other injuries were caused largely by the flying and falling débris.

One of the engineers of the Metropolitan Sewerage Commission estimates that the property damage amounts to about $50,000. While there is no direct evidence available as yet as to the cause of the explosion, the engineer quoted believes that it was caused by gasoline gas which may have been present in greater amount than ordinarily on account of the large amount of work done in automobile garages during Memorial Day and Sunday. The immediate cause is unknown and as the man who was at the center of the explosion was killed it is likely to remain a mystery.

Failure of the Dam of the Hatchtown Reservoir, Utah

BY GUY STERLING*

The earth dam of the Hatchtown Reservoir, located on the upper Sevier River, in Utah, 220 miles south of Salt Lake City, failed on the night of May 25, 1914. Previous to the failure indications of seepage had been noted by the watchman at the downstream toe of the dam near the end of the outlet culvert. During the afternoon of the day of the failure this seepage developed into several small but persistent streams. Large sections of the lower face then began to slip off and at 7 or 8 p.m. from 100 ft. to 140 ft. of the dam was swept away, releasing about 12,000 acre-ft. or over 500,000,000 cu.ft. of water, having at the point of failure a depth of 53 ft. The ensuing flood rushed for 46 miles down the Sevier River Valley, and about noon of the 26th inst. reached the Piute Reservoir, where its career was safely checked.

As soon as it was realized by the watchman that the dam was in danger of failure, warning was telephoned to the farmers and small communities scattered along the valley between the Hatchtown and Piute Reservoirs, and the inhabitants, comprising about 1000 people, promptly moved their families and most of their livestock and household belongings to higher ground.

Thanks to the promptness of the warning there was no loss of human life. Some livestock was lost, the crops of about 9000 acres of farms were probably partially destroyed, a few houses, several wagon bridges and 14 or 15 irrigation diversion dams were carried away. The total loss, including about $75,000 for the dam, is variously estimated at from $200,000 to $300,000. Owing to the general narrowness of the Sevier River Valley between the Hatchtown and Piute Reservoirs, to the space so fortunately available in the latter for the safe disposal of the flood and to the prompt warning sent down the valley by the watchman at the upper reservoir, the effect of the disaster was comparatively small.

From the information available at the present writing it appears extremely probable that the immediate cause of the failure was due to leakage along the outer surface of the outlet culvert, although nearly every year since the construction of the dam intermittent seepage has been noticed at a point 400 or 500 ft. from the culvert and at the easterly end of the dam.

Records available at the office of the State Engineer show that the Hatchtown dam had a maximum height of about 63 ft., a top length of 780 ft., top width 20 ft.,

*Civil Engineer, 635 Newhouse Building, Salt Lake City, Utah.

downstream slope 2½ to 1, upstream slope 2 to 1, that its outlet works consisted of a double compartment gate tower and chamber connected to a 5x8-ft. masonry culvert passing through the base of the dam at its deepest part; that its construction was authorized and paid for out of state funds by the Utah State Land Board in connection with the Hatchtown Irrigation project for the reclamation of about 6000 acres of land situated, from 12 to 20 miles below and northerly of the reservoir, on the east side of the Sevier River. The project including the reservoir was practically completed Nov. 30, 1908, when the storage of water began and has continued every year since. The preparation of the plans and specifications for the dam and its construction were carried out under the direction of Caleb Tanner, who was State Engineer at that time.

Further details regarding the character of the construction embodied in the dam and the causes of its failure can only become available from examination at the site of the dam, which is 60 miles from the nearest railway.

The dam of the Piute Reservoir, which so successfully opposed the progress of the flood from the Hatchtown reservoir, has a maximum height of about 93 ft. and has just been practically completed by the Utah State Land Board in connection with another State Irrigation project. This reservoir is said to have a capacity of 80,000 acre-feet at a level 15 ft. below the top of the crest of the dam. At the time of the failure of the Hatchtown Dam the Piute Reservoir contained 50,500 acre-ft. of water and consequently had available an unoccupied storage space of about 30,000 acre-ft. in which to absorb the 12,000 acre-ft. held in the Hatchtown Reservoir which had a maximum storage capacity of about 13,200 acre-ft.

At the time of the failure, there were in storage 30,000 acre-ft. in a reservoir on Otter Creek which joins the Sevier at the upper end of the Piute Reservoir. On the San Pitch River joining the Sevier about 75 miles below the Piute Reservoir, probably 20,000 acre-ft. were in storage. Still further down the Sevier are two other large reservoirs, all partly filled but having considerable unoccupied space. The dam of the Piute Reservoir and the dams of all the last mentioned reservoirs on the Sevier River system are built of earth and range from 40 to 70 ft. in height.

Governor Spry, of Utah, has ordered W. D. Beers, the present State Engineer, to make a report on the cause of the failure.

Notes from Engineering Schools

COLUMBIA UNIVERSITY—The fiftieth anniversary of the founding of the School of Mines was celebrated in New York, May 29. There was an academic procession to the University gymnasium where honorary degrees (Master of Science and Master of Arts) were conferred. There were addresses by T. A. Rickard, of London, Friedrich Kolbeck, of Freiberg, and Hennen Jennings, of Washington. The Chandler lectureship and medal were inaugurated by the address of Leo H. Bakeland. A tablet was presented by the Society of Older Graduates. There was finally a dinner at the Waldorf-Astoria Hotel, attended by some 600 alumni.

NEWS NOTES

A Street Railway's Purchase of its own stock for investment of reserves is seen in a recent proceeding authorized for the Cleveland Ry. Co. by the City Council.

An Active Volcano in California has made its appearance. Smoke and steam have been issuing from a new crater near the summit of Mount Lassen, in Shasta County, northern California, since May 29. It was last active about 50 years ago.

The Fourth and Last Pin of the Williamsburg Bridge, across the East River at New York City, was successfully replaced during the night of May 28-29. This completes the operation of substituting 13-in. for 10-in. pins in the stiffening trusses adjacent to the main towers, as fully described in our issue of May 14, 1914, p. 1082.

Coöperative Forestry Arrangements have been made between the city of Tacoma, Wash., and the U. S. Forest Service for the protection of the source of the city water supply —the watershed of the Green river which lies within the Rainier national forest. The two agencies working together will protect this stream from the results of forest destruction by fire or by other agencies.

The Wakefield (Mass.) Municipal Electric plant will be shut down owing to inadequacy; it has been run before under a municipal commission, but the town has had to purchase energy also from the Reading municipal station. The town load will now be carried by the Boston Edison Co., using 2300/4000-volt, four-wire, 60-cycle alternating-current system to yield single-phase service for lighting and three-phase service for power. Duplicate lines will be run.

The Belleville (Ohio) 14-Foot Penstock which collapsed under the weight of the contained water early in 1914, when first filled, and which was later washed away by the flood (see "Engineering News," May 1, 1913, p. 909, and May 29, 1913, p. 1127, for details of collapse) has been rebuilt practically as originally designed, but with the addition of the tie-rods on the horizontal diameter. Reports are that it is not yet in finally satisfactory shape, and there is some trouble with leakage.

American Society of Civil Engineers in Convention Approves Code of Ethics—The proposed code of ethics of the American Society of Civil Engineers (see "Engineering News," Apr. 30, 1914, p. 987), which has been recommended by the Board of Direction, was submitted to the business meeting of the society at the annual convention at Baltimore, Md., June 2. After considerable discussion and the voting down of several proposed amendments, it was finally voted that the sense of the meeting was in favor of the adoption of the proposed code, and that it be referred to the members of the society for action by letter ballot.

A Plan to Sell the Battleships "Idaho" and "Mississippi" to a foreign power for the price paid by the United States for their construction, was laid before the Senate Naval Affairs Committee on May 28 by Secretary Daniels. According to press dispatches the proposal met with the approval of the majority of the committee and an amendment embodying the plan was prepared for presentation to the Senate. The "Mississippi" and the "Idaho" cost respectively $5,832,000 and $5,894,000. The ships have been in commission since 1908. The United States has never sold battleships to a foreign power, although it has condemned ships and afterward sold them without armament.

A 48-in. Water Main Broke in Philadelphia, Penn., at 6 a.m., on May 28, at the Lardner's Point dumping station, flooding the station and reducing the water supply in about 60% of the city. The station was shut down for about 24 hours while fire engines pumped out the water, and the break was repaired. During this period the emergency supplies from the Wentz Farm, Oak Lane and Queen Lane reservoirs were turned into the mains in the trouble zone. The director of public health issued instructions that householders in the zone boil the water used for the next few days.

The break occurred at 6 a.m.; at 7 a.m. repair work began; at 9 a.m., the emergency water was turned on; and on May 30, nine of the twelve pumps were in service.

An Unloaded Timber Highway Bridge Collapsed at Dayton, Ore., at 4 a.m., on May 26. The bridge, which spanned the Yamhill River, was 400 ft. long, 70 ft. high, and rested on concrete piers. Local press reports (sent us by Henry Blood, of Portland, Ore.) state that about an hour before the collapse an automobile, traveling swiftly, was heard to cross the bridge. This was followed by much creaking and break-

ing of timbers until the final collapse. The failure, apparently, was due directly to weakened connections between members, caused by vibration, or to secondary stresses imposed by the speeding automobile, and indirectly by neglect. The bridge, built in 1890 by Yamhill County, was part of an important highway, and bore considerable vehicle traffic.

A 30,000-Hp. Hydro-Electric Plant in South Carolina was Opened May 30 under the direction of E. W. Robertson, President of the Parr Shoals Power Co., near Columbia, S. C. This company is a subsidiary of the Columbia Ry. Gas & Electric Co., and the new plant supplements the steam and hydro-electric stations, totaling about 14,500 hp., of the main company. The new development includes a masonry dam 2200 ft. long across the Broad River about 30 mi. above Columbia. The fireproof power house contains five generating units operating at 35-ft. head, of 18,000 hp. aggregate capacity. Transmission will be at 60,000 volts over a double-circuit steel-tower transmission line to Columbia. The work was done by the J. G. White Engineering Corporation, of New York City.

A New $1,000,000 Wing of the British Museum was recently completed, and formally opened by King George and Queen Mary on May 7. The building is in architectural harmony with the old museum. Its facade, flanked by two massive towers, is of Portland stone; the outer walls and pedestals of the forecourt being of Scotch granite. The doorway is of marble surrounded by granite, and closed by a bronze door the upper panels of which are sculptured in relief. Inside, a stairway connects the old and the new portions. The building comprises a subbasement, basement, ground, mezzanine, and top floors. The latter will accommodate the print department. Books and newspapers will be stored in the basement. The mezzanine floor will be used for office space, and the music and map collection.

The Armored Railway Cars in use in military operations in Mexico by the Federal forces and to some extent by the revolutionists are said to have been originally built for the Diaz government during the operations against Madero. The cars were designed and built by the Orenstein-Arthur Koppel Co., of Koppel, Penn. They are 35 ft. long and 9 ft. wide, with their roof 12 ft. 5 in. above the rail. The walls and roof have two thicknesses of steel plate and the 4-in. space between is filled with sand and concrete. Port holes are provided in the sides and ends of the car and there is a steel plate floor. The interior of the car is fitted up with bunks, shelves, drinking water storage, etc. The cars have small doors capable of being locked from the inside and when so locked the car is entered by a trap door in the roof.

The Charles River Basin between Boston and Cambridge, Mass., has been stocked with trout, perch, and other fish by the Massachusetts Fish & Game Commission. These have multiplied to such an extent, we are informed, that under certain restrictions fishing in the basin is now to be permitted. The estuary of the Charles River was closed to the tides and the gates of the shut-off dam dropped and the construction of the earth dam begun about six years ago (see "Eng. News" Nov. 5, 1908). Notwithstanding the fact that the basin has received the fresh upland water for so long a time its water is still brackish in the deeper parts, owing, it is said, to the admission of sea water with vessels locked into the basin at high tide. The fish chosen to stock the basin were selected, we understand, with the conditions prevailing in the water in view. It is expected that the basin will supply a large amount of fish annually.

A New Canadian Lightship Was Wrecked on Crook's Ledge on the eastern shore of Nova Scotia, on May 24. The entire crew, numbering 25, is reported lost. The new lightship "Halifax No. 19," built for Halifax harbor, was on her way from Glasgow, Scotland. She was out of her course when she struck. The heavy sea dashed her high up on the rocks. The "Halifax No. 19" was 135 ft. in length overall, with 29-ft. beam. She was constructed of steel and displaced 670 tons. Her speed was about 10 knots per hour. She was equipped with wireless apparatus, but it had not yet been connected. The ship was still the property of the builders whose contract provided for her delivery at Halifax. The lighting equipment and power were to be installed at Halifax, that she might be more seaworthy on the transatlantic voyage. The "Halifax No. 19" was commanded by Captain McBeth, who was 71 years old and a sailor of more than 50 years' experience.

The Pittsburgh to Lake Erie Canal project has received a pronounced impetus by the appointment, on May 27, by Gov. Tener, of Pennsylvania, of the Lake Erie and Ohio Canal Commission, which was authorized by the last Pennsylvania legislature. The purpose of the Commission is to take up the preliminary work for the construction, if feasible, of a ship canal connecting Pittsburgh to Lake Erie through the Beaver and Mahoning valleys. The first duty of the Commission will be to survey routes under an appropriation of $150,000.

Gov. Tener appointed to the Commission the following members: President, ex-Mayor of Pittsburgh W. A. Magee; A. S. McSwigan, Pittsburgh; Tom P. Sloan, Lock Ne[illegible]; James A. Chambers, Pittsburgh; Thomas W. Symons, Colonel, Corps of Engineers, U. S. A., retired. Col. Symons is the only engineer member of the Commission, which has authority to appoint such engineering employees as may be needed. The President receives $5000 and the other members each $4000 per year.

Commission Government for Alaska is recommended by Secretary Franklin K. Lane, of the Interior Department in a report just made to the House and Senate committees on territories. Mr. Lane urges that an Alaska development board be created by Congress to consist of three members and to take over all the authority now exercised by various departments and bureaus at Washington. This board would do the work which is now supposed to be done for Alaska by the General Land Office, the Forest Service, the Road Commission, the Bureau of Mines, the Bureau of Education and the Secretary of the Interior and nearly a score of other government bureaus in Washington, scattered among the various departments. Under such complicated and conflicting administration, exercised thousands of miles distant from the place where work is to be carried on, efficient government is impossible, and the development of the resources of Alaska is hopeless. The current receipts from Alaska are now about $800,000 per annum, while the total expenditures of the government on account of Alaska are over $5,000,000.

Rail Failures in New York State are reported to the Public Service Commission, Second District. These have been particularly severe in the winter months. The first three months of the past ten years show results as follows:

1905	1331	1910	1640
1906	826	1911	1456
1907	3014	1912	3580
1908	3408	1913	1122
1909	1280	1914	1724

The comparison by months for the past three years is as follows:

	1914	1913	1912
January	390	347	1283
February	734	391	1124
March	600	384	1173
	1724	1122	3580

The 1912 high figures are largely the result of the severe winter, coupled perhaps with poorer steel. The three months of 1914 cited apply to weather almost as severe as in 1912 (1913 was mild) and indicate an aparent improvement in steel.

A New Record in Placing Masonry—The placing of masonry in Kensico Dam during the season of 1913 was described in "Engineering News," May 21, 1914. A total of 316,000 cu.yd. of masonry was placed in 200 working days of eight hours each, the best day's record being 2250 cu.yd.

The present season opened on March 17, and up the May 25 a total of 120,900 cu.yd. have been placed. For the month ending May 24, including 24 working days, 65,290 cu.yd. of masonry was placed, or a daily average of 2720 cu.yd. The best day's work being 3165 cu.yd. on May 19, of which 155 cu.yd. was facing and expansion joint blocks.

The concrete was made in three gravity mixers to which the materials were supplied by electrically driven belt conveyors fed from gravity bins, to which the crushed stone and sand were delivered from overhead railroad tracks. The best day's product from any one mixer for the month of May was 507 batches of 2 cu.yd. This last month's work is believed to have been exceeded only at the Panama Locks, and is a new record for masonry dam construction. Kensico dam is now completed to Elev. 242 ft. for a length of 1000 ft., and work on the lift from Elev. 242 to 264.5 is already under way.

PERSONALS

Mr. J. D. Fidler, former Secretary of the Acme Cement Plaster Co., St. Louis, Mo., is now Traffic Manager of the Walter A. Zelnicker Supply Co., also of St. Louis.

Mr. J. T. Loree, Trainmaster of the Delaware & Hudson Co., at Oneonta, N. Y., has been promoted to be Division Superintendent at Oneonta, succeeding Mr. J. F. Rosenstock, resigned.

Mr. A. G. Hall, M. Am. Soc. M. E., has resigned as Smoke Inspector of the city of Cincinnati, Ohio, to become Chief Engineer of the new Cincinnati Hospital, at a salary of $3000 per annum.

Mr. G. M. Hall has resigned as General Manager of the Hollbrook Irrigation Ditch Association, Rocky Ford, Colo., to become the Manager of a large irrigation association at Twin Falls, Idaho.

Mr. William L. Staley, for the past seven years in mining engineering and power-plant work in California and the Southwest, has opened an office at Albuquerque, N. M., as a Consulting Engineer and Surveyor.

Mr. Stephen DeM. Gage for the past 18 years Biologist at the Lawrence Experiment Station of the Massachusetts State Board of Health has resigned to become Chief Chemist of the State Board of Health of Rhode Island.

Mr. Orville Wright, of Dayton, Ohio, has been awarded an Elliott Cresson gold Medal of the Franklin Institute of Philadelphia in recognition of the epoch-making work accomplished by him in the science and art of aviation.

Mr. G. H. Dirhold, for several years Advertising Manager of the Simmons Hardware Co., and formerly Editor of "Hardware," New York City, has been appointed Advertising Manager of the Walter A. Zelnicker Supply Co., St. Louis, Mo.

Dr. Edgar Fahs Smith, Professor of Chemistry at the University of Pennsylvania, has been awarded an Elliott Cresson Gold Medal of the Franklin Institute of Philadelphia, for his investigations in the field of inorganic chemistry, especially in electro-chemistry.

Mr. O. S. Bowen, M. Am. Soc. C. E., Resident Engineer of the Great Northern Ry., Seattle, Wash., has been promoted to be Principal Assistant Engineer, with headquarters at Spokane, Wash., succeeding Mr. Alexander Stewart, granted leave of absence on account of ill health.

Mr. Clement K. Quinn has resigned as Chief Engineer of the Inter-State Mining Co., the mining subsidiary of the Jones & Laughlin Steel Co., of Pittsburgh, Penn., to become Manager of the mines of a newly formed syndicate, which will operate on the Lake Superior iron ranges, with offices in Duluth, Minn.

Mr. G. B. Vilas, recently Assistant General Superintendent of the Chicago & Northwestern Ry., at Chicago, Ill., has been promoted to be General Superintendent, succeeding Mr. W. J. Towne, promoted, as noted in our issue of last week. Mr. Vilas began his railway experience with the Chicago & Northwestern Ry. in 1887 as a telegraph operator.

Dr. Karl Paul Gottfried Linde, of Munich, Germany, has been awarded an Elliott Cresson Gold Medal of the Franklin Institute of Philadelphia, for his scientific investigations of the processes of refrigeration and the liquefaction of gases, and for his inventions of machinery for applying these processes in the manufacture of ice and for purposes of cold storage.

Mr. Montague Ferry, Assoc. Am. Inst. E. E., recently City Telephone Supervisor, Chicago, Ill., has been appointed Commissioner of Public Service of Chicago. Mr. Ferry is 33 years old and a graduate in electrical engineering of the Massachusetts Institute of Technology, class of 1903. The Bureau of Public Service is a new one. An important part of its work will be the compiling of statistics to be used in the preparation of rate-regulation ordinances.

Mr. C. W. Boynton, for the past ten years Inspecting Engineer of the Universal Portland Cement Co., Chicago, Ill., has resigned to take charge of the construction and operation of the properties of the Sonoma Magnesite Co., in California. He was formerly with the Baltimore & Ohio R.R. Mr. W. M. Kinney, Assistant Inspecting Engineer, who has been in charge of the Universal Inspection Bureau in Pittsburgh, Penn., for the past six years, succeeds Mr. Boynton at Chicago.

Mr. Alfred Ludwig, formerly Chief Inspector of the Bureau of Buildings, Borough of Manhattan, New York City, who has been Acting Superintendent of Buildings since the resignation of Mr. Rudolph P. Miller, M. Am. Soc. C. E., as noted in our issue of Apr. 16, has been appointed Superintendent of Buildings. It is announced that the appointment is made to avoid any chance of a dispute as to the legality of any acts of the bureau. Mr. Miller is expected to return to his former position when the work of his present assignment is completed.

Mr. Joseph Johnson, former Commissioner of the Fire Department of the city of New York, has been appointed Chief of the Bureau of Transit of the Public Service Commission, First District, New York State, at a salary of $7500 per annum. The following report of his appointment is from the New York "Times":

Mr. Johnson's appointment was voted, 3 to 2, Chairman McCall and Commissioners Williams and Cram voting for and Commissioners Eustis and Maltbie against him. Johnson's opponents said they had no personal objections to him, but they thought the work needed a man of special training. Chairman McCall pointed out that engineering knowledge was of little value in the work compared with strength of character and initiative.

OBITUARY

Dr. Joseph Edward Stubbs, President of the University of Nevada, died at his home in Reno, Nev., May 27.

Jeremiah Lott, General Manager of the Flatbush Water Co., of Brooklyn, N. Y., died May 26, aged 70 years.

James J. Ferris, until recently one of Commissioners of Jersey City, N. J., died May 15, aged 53 years. He was a prominent public-works contractor.

Harold Stevens, a young civil engineer employed by the firm of Blair & Drain, Charlotte, N. C., was drowned in the Yadkin River near that city on May 20, while canoeing.

Jacob O. Brinkerhoff, Superintendent of the Kansas division of the Union Pacific R.R., at Kansas City, Mo., died May 22. He was born in New York State in 1839, and entered the railway service in 1865 as a brakeman on the Union Pacific R.R.

Charles F. Nagle, Chief Engineer, U. S. N., retired, died at his home in Brooklyn, N. Y., May 26. He was born in Ireland, Sept. 4, 1841, and entered the United States Navy as Third Assistant Engineer in 1863. He was made Passed Assistant Engineer in 1874 and retired with the rank of Chief Engineer in 1892.

Sir Joseph W. Swan, Hon. M. Inst. E. E., died in London, England, May 27, aged 86 years. He was born Oct. 31, 1828. He was chiefly noted as the inventor of an incandescent electric lamp and of photographic processes. He was a Past-President of the Institution of Electrical Engineers, of the Faraday Society and of the Society of Chemical Industry.

Robert Kay Gray, Past-President of the Institution of Electrical Engineers, died at his home in East Wickham, England, May 2. He was born in Scotland in 1851. He was for many years connected with the telegraph and electric lighting industry of England. He was a member of the Institution of Civil Engineers, the Institute of Metals, the Royal Institution and the Royal Society of Arts.

ENGINEERING SOCIETIES

COMING MEETINGS

MASTER CAR BUILDERS' ASSOCIATION.
June 10-12. Annual convention at Atlantic City, N. J. Secy., Jos. W. Taylor, 1112 Karpen Building, Chicago, Ill.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.
June 12. Semi-annual convention of Atlantic City. Secy., Jas. A. Andrewcetti, C. & N. W. Ry., Room 411, Chicago, Ill.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS.
June 11-13. Annual meeting at Toledo, Ohio. Secy., Frank E. Sanborn, Columbus, Ohio.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.
June 15-17. Annual convention at Atlantic City, N. J. Secy., Jos. W. Taylor, 1112 Karpen Building, Chicago, Ill.

AMERICAN SUPPLY AND MACHINERY MANUFACTURERS' ASSOCIATION.
June 15-17. Annual convention at White Sulphur Springs, W. Va. Secy., F. D. Mitchell, Woolworth Building, New York City.

SOUTHWESTERN WATER-WORKS ASSOCIATION.
June 15-17. Annual meeting at Tulsa, Okla. Chairman of Arrangements, L. L. Ballard, Tulsa, Okla.

TRAIN DISPATCHERS' ASSOCIATION OF AMERICA.
June 16-19. Annual convention at Jacksonville, Fla. Secy., John F. Mackie, 7122 Stewart Ave., Chicago, Ill.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
June 16-19. Spring meeting at St. Paul and Minneapolis, Minn. Secy., Calvin W. Rice, 29 W. 39th St., New York City.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.
June 17-20. Sixth semi-annual meeting at Troy, N. Y. Secy., J. C. Olsen, Polytechnic Institute, Brooklyn, N. Y.

SOCIETY OF AUTOMOBILE ENGINEERS.
June 23-26. Annual convention at Cape May, N. J. Chairman of Arrangement Committee, Arthur B. Cummer, 1790 Broadway, New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
June 23-26. Thirty-first annual convention at Detroit, Mich. Secy., F. L. Hutchinson, 29 W. 39th St., New York City.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.
June 23-26. Annual meeting at Princeton, N. J. Secy., Henry H. Norris, 29 W. 39th St., New York City.

AMERICAN SOCIETY FOR TESTING MATERIALS.
June 30-July 4. Seventeenth annual meeting at Atlantic City, N. J. Secy., Edgar Marburg, University of Pennsylvania, Philadelphia, Penn.

AMERICAN SOCIETY OF ENGINEERS, ARCHITECTS AND CONSTRUCTORS.
July 3-4. Convention at Brighton Beach, L. I. Secretary, T. Hugh Boorman, 520 E. 20th St., New York City.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.
July 9-11. Semi-annual meeting at Cleveland, Ohio. Secy., J. J. Blackmore, 29 W. 39th St., New York City.

OHIO ELECTRIC LIGHT ASSOCIATION.
July 16-19. Annual convention at Cedar Point, Ohio. Secy., D. L. Gasgill, Greenville, Ohio.

American Public Health Association—The annual meeting will be held in Jacksonville, Fla., Dec. 1-5. The secretary is Dr. J. L. Harris, St. Louis, Mo.

Engineers' Society of Western Pennsylvania—At the regular monthly meeting, held in the Carnegie Institute, May 13, the Society was addressed on the subject of "River Control in the Ancient World and the Lessons for the Present Day," by Sir William Willcocks.

American Association of Railroad Superintendents—The 1914 convention of the Association will be held in New York City, Aug. 20-21, in quarters provided by the Merchants' Association of New York. The Secretary is E. H. Harman, Room 101, Union Station, St. Louis, Mo.

Special Libraries Association—The annual convention of the Association, which is affiliated with the American Library Association, Washington, D. C., will be held in Washington, May 27-28. The Association is composed chiefly of the business libraries which have commercial, industrial, financial and engineering interest. The Secretary is George E. Marion, 93 Broad St., Boston, Mass.

Texas Levee and Drainage Association—This Association was recently organized, and a vigorous campaign launched, for the reclamation of about 3,000,000 acres in Texas now subject to overflow. The meeting was held in Dallas, and attended by about 100 farmers and business men of Texas. C. W. Elliott, of Paris, Tex., was made Chairman, with James B. Stover, of Dallas, Secretary.

Society of Automobile Engineers—The summer meeting will be held at Cape May, N. J., June 23-26, with headquarters at the Hotel Cape May. Two sessions will be held each day. The semi-annual dinner will take place on June 25. A number of entertainment features are planned. The chairman of the General Committee of Arrangements is Arthur B. Cumner, 1790 Broadway, New York City.

International Garden City and Town-Planning Association—This Association, to which are affiliated many important housing and town-planning bodies, proposes to hold its congress and tour in England during July. The tour will extend over 16 days and cost about $55 per member. An extension tour in Scotland has been planned, the cost of which will be the same as for the English tour. Arrangements are in charge of Ewart G. Culpin, 3 Grays Inn Place, Grays Inn, London, W. C., England.

American Institute of Electrical Engineers—At the annual business meeting of the Institute on May 12 the officers for the year commencing Aug. 1, 1914, were announced as follows: President, Paul M. Lincoln; Vice-Presidents, H. H. Barnes, F. S. Hunting, J. A. Lighthipe, Farley Osgood, C. F. Scribner and N. W. Storer; Managers, C. A. Adams, Frederick Bedell, B. A. Behrend, J. H. Finney, Bancroft Gherardi, Wm. B. Jackson, Peter Junkerfeld, H. A. Lardner, A. S. McAllister, Wm. McClellan, Lewis B. Robinson and H. Franklin Stevens; Treasurer, George A. Hamilton; Secretary, F. L. Hutchinson. The membership of the Institute is stated to comprise five honorary members, 439 fellows, 1027 members and 6405 associates; making a total of 7876, a net increase of 222 since Apr. 30, 1913.

American Institute of Electrical Engineers—The program for the 31st annual convention of the Institute, to be held in Detroit, Mich., June 22-26, has just been issued. Among the committee reports and papers to be presented are the following: "Electric Heating as Applied to Marine Work," C. S. McDowell and D. M. Mahood; "Electrically Driven Gyroscope in Marine Work," H. C. Ford; "Direct-Current Motors for Coal and Ore Bridges," R. H. McLain; "The Sphere Gap as a Means of Measuring High Voltage," F. W. Peek, Jr.; "Data on High Tension Transmission Systems"; "Specifications for High Tension Insulators"; "Prime Movers," H. G. Stott, W. S. Gorsuch and R. J. S. Pigott; "Voltage Testing of Cables," W. I. Middleton and Chester L. Dawes; "Sterilization of Water by Ultra-violet Rays," M. Von Recklinghausen; "A High-Speed Printing Telegraph System," Carl Kinsley; "Method of Keeping Down Peak on Power Purchased on the Peak Basis," T. E. Tynes; "Electric Strength of Air," J. B. Whitehead and W. S. Gorton; "Sphere-Gap Discharge Voltages at High Frequencies," J. C. Clark and H. J. Ryan; "Toll Telephone Traffic," Frank F. Fowle.

Traveling Engineers' Association—The 22d annual convention of this association whose purpose is to improve the locomotive service of American railroads, will be held at Chicago, Ill., Sept. 15-19, with headquarters at the Hotel Sherman. The subjects to be discussed this year are as follows: "Difficulties Accompanying Prevention of Dense Black Smoke and Its Relation to Cost of Fuel and Locomotive Repairs," Martin Whalen, Chairman of Committee; "Operation of All Locomotives, with a View of Obtaining Maximum Efficiency at Lowest Cost," J. R. Scott, Chairman; "Advantages to be Derived from the Use of Mechanical Stokers, Considering (1) Increased Efficiency of the Locomotive; (2) to Increase the Possibility of Securing a Higher Type of Candidate for the Position of Fireman, (3) the Utilization of Cheaper Grades of Fuel," J. H. De Salis, Chairman; "The Care of Locomotive-Brake Equipment," George H. Wood, Chairman; "Advantage Derived from the Use of Speed Recorders, and Their Influence on Operating Expense," Fred Kerby, Chairman; "Practical Chemistry of Combustion," A. G. Kinyon; "Scientific Train Loading," O. S. Beyer, Jr. The Secretary is W. O. Thompson, New York Central car shops, Buffalo, N. Y.

International Engineering Congress—The materials of engineering construction will be pretty thoroughly discussed in a section devoted to that subject. The subject of timber is intended to be covered by a symposium from various countries on the status of the main supplies commercially available for construction. Other topics are: Substitutes for Timber in Engineering Construction; Brick in Engineering Structures; Clay Products in Engineering Structures; Probable and Presumptive Life of Concrete Structures Made from Modern Cement; Aggregates for Concrete; Slag Cement; Waterproof Concrete; Cement Containing Additions of Finely Ground Foreign Material; Economics of the World's Supply of Iron; Life of Iron and Steel Structures; Employment of Special Steel in Construction; Alloys and their Use in Engineering Construction; Aluminum in Construction; Influence of the Testing of Materials upon Advances in the Design of Engineering Structures and Machines; Cement Testing; Testing of Metals; Testing of Full-Sized Members; Proof Testing of Structures.

The papers to be presented from the United States are stated to have already been arranged for from recognized leading authorities. The headquarters of the Congress is in the Foxcroft Building, San Francisco, Calif.

American Society of Engineers, Architects and Constructors—This Society was recently organized for the purpose of "Promoting science and instruction in the departments of civil engineering, architecture, engineering and building construction and the arts allied thereto, and for promoting and fostering fraternal and protective interest among its members." The qualifications for the various grades of membership are as follows:

(a) Engineers—Requirements equal to those of the American Society of Civil Engineers; (b) Architects—Requirements similar to those in the American Institute of Architects. (c) Construction—Ten years of practice in the designing or actual supervision of work, of which may be credited prior college designing, mechanical or factory experience. Associates must have connections with the manufacture or supply of materials used under specifications of engineers and architects. Juniors are those preparing for entrance into full membership.

Initiation fees for all classes are $5. The annual dues both for active and associate members are $5; Juniors' annual dues are $3; life membership is $100. The officers for 1914 are: President, Major Samuel S. Hatfield; First, Second and Third Vice-Presidents, Oliver Randolph Parry, Chas. N. Green, H. F. Hackendorn, respectively; Treasurer, Chas. F. Dingman; Secretary, T. Hugh Boorman, 35 West 39th St., New York City. The first regular monthly meeting was held in New York on May 12; the subject of the evening being "subsurface Structures of New York City," by Chas. N. Green. A midsummer convention will be held at Brighton Beach, New York City, July 3-4.